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CONTRIBUTIONS TO THE GEOLOGY AND PALAEONTOLOGY OF THE WEST INDIES.

MIOCENE MOLLUSKS FROM BOWDEN JAMAICA.

BY

WENDELL P. WOODRING.

PELECYPODS AND SCAPHOPODS.

JUN 27 1925

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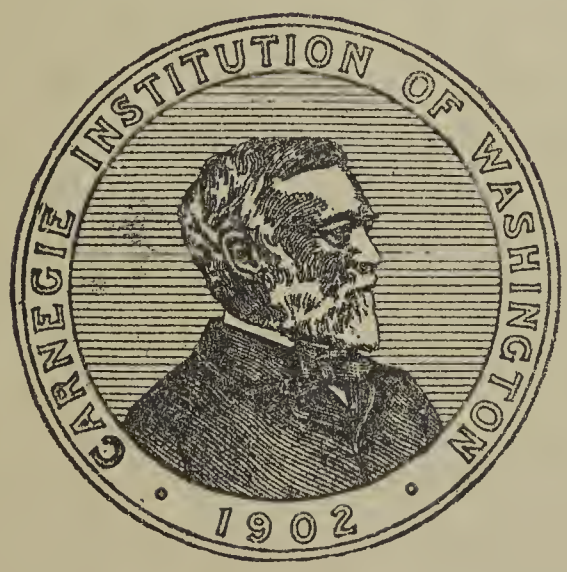

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MIOCENE MOLLUSKS FROM BOWDEN, JAMAICA

PELECYPODS AND SCAPHOPODS

By Wendell P. Woodring

INTRODUCTION.

This report is one of a series dealing with the geology and palaeontology of the West Indies prepared under the general direction of Dr. T. Wayland Vaughan. I wish to express my deep obligations to Dr. Vaughan for his sustained interest in the work and for the assistance he has given in many ways. The paper contains a brief discussion of the deposits that furnished the fossils and descriptions of the pelecypods and scaphopods. It is expected that another part may be issued comprising descriptions of the gastropods and a discussion of the fauna and its significance.

The examination of the fossils described in this report was begun at Johns Hopkins University in 1915. A fund collected by Dr. William Bullock Clark, who was then head of the Department of Geology, was applied to a continuation of the work, and its completion was made possible by a grant from the Carnegie Institution of Washington.

It was soon discovered that a review of the generic nomenclature was necessary in order to make effective comparisons with tropical Miocene mollusks in other parts of the world and to trace the former and present distribution of the genera. The greatest difficulty arose from the determination of type species. In fixing the types of genera I have attempted to follow rigidly the International Code of Zoological Nomenclature. Article 30 (*g*) of the Code states that—

> "If an author, in publishing a genus with more than one valid species, fails to designate or to indicate the type, any subsequent author may select the type, and such designation is not subject to change. (Type by subsequent designation.) The meaning of the expression 'select the type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type."

It was obviously impossible to search all the literature written on mollusks in order to discover the earliest designated type for such genera. A paper by J. E. Gray, entitled "A list of the genera of Recent Mollusca, their synonyma and types," published in the Proceedings of the Zoological Society of London, part 15, pages 129 to 219, 1847, has been of great value. In this paper the types of many old genera were fixed, although many writers have disregarded it. In order to prevent any misunderstanding, I have followed Iredale's example in giving the reason for the selection of the type of each genus, subgenus, and section. The authority for subsequent designation is given for subsequently designated types except for some

genera that would have involved too extensive a search. Some of these subsequently designated types may be erroneous, as earlier designations may have been overlooked. The description of each group is based on an examination of the type species unless otherwise designated.

According to many palaeontologists and malacologists, the generic names in the Museum Boltenianum are available under the Code. This matter is now under consideration by the International Commission of Zoological Nomenclature. Unfortunately these Bolten names displace many long-established names.

This time-consuming task of attempting to discover what generic names should be used has no direct bearing on the history of the earth and therefore may seem like wasted time for a palaeontologist. But if the significance of the genera composing a fauna is considered, and their rise, spread, and restriction are analyzed, the uniform use of generic names is essential.

The extensive collections of Tertiary and living mollusks in the United States National Museum have been used in making comparisons with the Bowden mollusks. Unless otherwise designated the comparisons are based on an examination of specimens.

The specimens described in this report are in the collections of the United States National Museum and Johns Hopkins University. The United States National Museum collections include the Guppy collection, which contains many of Guppy's types, and collections made by J. B. Henderson, jr., and C. T. Simpson in 1894, and R. T. Hill in 1896. The Johns Hopkins University collections include material sent in 1899 by J. E. Duerden while he was residing in Kingston, Jamaica, and collections acquired at different times by T. H. Aldrich, of Birmingham, Alabama. I have also had access to collections at the Philadelphia Academy of Natural Sciences. All these collections come from one locality at Bowden (see p. 7); therefore this locality is the type locality of all the new species and is not repeated in the descriptions of the species.

I wish to record my grateful thanks for assistance and criticism freely given. Professor W. B. Clark and Professor E. W. Berry generously helped in many ways during the early part of the work. Dr. T. Wayland Vaughan gave assistance and criticism in interpreting the fauna in relation to the geologic history of the West Indies. Dr. Paul Bartsch gave access to the facilities of the Division of Mollusks of the United States National Museum and constantly gave

advice. Dr. W. H. Dall, whose "Tertiary Fauna of Florida" is the starting-point of any work dealing with American Tertiary mollusks, gave access to the collections of Tertiary mollusks in the United States National Museum and generously gave advice. Dr. Julia Gardner kindly helped in the identification of fossils and in the interpretation of the fauna. Dr. H. A. Pilsbry gave opportunities to study types at the Philadelphia Academy of Natural Sciences. Photographs of the type of *Arca antiquata* Linné, reproduced as figures 1 and 2 on plate 4, were furnished by B. Daydon Jackson, general secretary of the Linnean Society of London. L. R. Cox, of the Department of Geology, British Museum, furnished catalogue numbers of the types of Miocene mollusks from Jamaica described by R. J. L. Guppy, and also of Miocene mollusks from the Dominican Republic described by G. B. Sowerby and by R. J. L. Guppy.

MARINE TERTIARY DEPOSITS OF JAMAICA.

The geological map published in 1869 as part of the report of the official survey[1] still is the most detailed geological map of Jamaica. A revised but more generalized map was issued by R. T. Hill in1899.[2] Hill's map corrected some mistakes on the earlier map and made other changes, some of which have not been verified by later work.[3]

In 1921, Dr. C. A. Matley, who had recently been appointed Government Geologist of Jamaica, investigated the water resources of parts of the island where the stratigraphy of the Tertiary deposits was an essential feature. During the next year Dr. Matley brought to Washington extensive collections of Tertiary fossils, principally from the parishes of Trelawny and St. Ann. The brief account on the following pages is based principally on these collections, which were examined by Dr. T. W. Vaughan and myself, and on information furnished by Dr. Matley.

Dr. C. T. Trechmann and others have recently published several valuable papers dealing with early Tertiary deposits and their fossils.

EOCENE.

The Carbonaceous Shale (Richmond beds of Hill) is the oldest Tertiary deposit in Jamaica. According to Trechmann,[4] mollusks in conglomerates in the lower part of the deposit indicate a lower Eocene (Cuisian, Sparnacian, or Thanetian) age. At places where the carbonaceous shale is missing, it may be represented by a part of the overlying Yellow Limestone.

The middle Eocene (Lutetian) Yellow Limestone (Cambridge formation, in part, of Hill) overlies the Carbonaceous Shale, but at places rests directly on Upper Cretaceous limestone, or is separated from it by only a few feet of shale. Trechmann[5] has recently described the mollusks of the Yellow Limestone. Its tropical fauna differs in many features from the middle Eocene faunas of the Gulf States of the

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[1] James G. Sawkins, and others, Reports on the geology of Jamaica. Part 2 of the West Indian Survey, Mem. Geological Survey [Great Britain], 339 pp., map, 8 unnumbered plates (sketches and sections), 6 text-figs. (one unnumbered). 1869. The map is dated 1865.

[2] Robert T. Hill, The geology and physical geography of Jamaica; study of a type of Antillean development. Bull. Mus. Comp. Zool. Harvard College, vol. 34 (geological series, vol. 4), 256 pp., 41 plates, 40 text-figs. 1899.

[3] C. A. Matley, Report on the work of the Government Geologist and on the progress of the Geological Surveys in Jamaica for economic purposes. Jamaica Gazette Supplement, vol. 46, No. 9, pp. 225–231. July 4, 1923. (See p. 226.)

[4] C. T. Trechmann, The Carbonaceous Shale or Richmond Formation of Jamaica. Geol. Mag., vol. 61, pp. 2–19, plates 1, 2. 1924.

[5] C. T. Trechmann, The Yellow Limestone of Jamaica and its Mollusca. Geol. Mag., vol. 60, pp. 337–367, plates 14 to 18. 1923.

United States, and according to Trechmann is similar to the Eocene fauna of Senegal. The Yellow Limestone also carries Foraminifera of the genera *Discocyclina, Operculina,* and *Dictyoconus.* The species of *Dictyoconus* are similar to some recently described from deposits of the same age in the Republic of Haiti.[1] The echinoids of the Yellow Limestone, recently described by Dr. Hawkins,[2] support the evidence furnished by the mollusks that the Yellow Limestone is of middle Eocene age.

Overlying the Yellow Limestone is the White Limestone (Montpelier beds, Moneague and Cobre formations of Hill), which covers a large part of Jamaica. Dr. Matley's collections show that the White Limestone includes deposits ranging in age from upper Eocene to upper Oligocene or lower Miocene. The lower part, of upper Eocene (Priabonian) age, carries Foraminifera of the genera *Alveolina* and *Dictyoconus.* A zone carrying both *Alveolina* and *Dictyoconus* underlies a zone containing only *Dictyoconus.* This part of the White Limestone seems to be the equivalent of similar shoal-water white limestones in the nearby islands of Haiti and Cuba and other parts of the West Indies.

OLIGOCENE.

A zone of the White Limestone carrying small lenticular species of *Lepidocyclina* may be of lower Oligocene (Lattorfian) age. A bed near Claremont in the parish of St. Ann, which underlies known middle Oligocene deposits, carries a remarkable gigantic lucinoid mollusk, described by Dall[3] as *Lucina megameris,* and another curious fossil that seems to be a gigantic *Verticordia.* Dr. Matley later discovered *"Lucina" megameris* at a locality near Kingston in beds containing *Dictyoconus.* The *"Lucina" megameris* beds may be upper Eocene or lower Oligocene.

A considerable part of the White Limestone carries large species of *Lepidocyclina,* similar to species characteristic of the middle Oligocene (Rupelian) limestone of Antigua and other parts of the West Indies and of Georgia, Florida, and Alabama. These deposits in Jamaica also contain many mollusks, but most of the specimens are casts or impressions. *Orthaulax pugnax* (Heilprin), which has been found in middle and upper Oligocene deposits elsewhere, is represented by

[1] W. P. Woodring, in W. P. Woodring, J. S. Brown, and W. S. Burbank. Geology of the Republic of Haiti, Appendix 1, pp. 608–609, plate 9. 1924.

[2] H. L. Hawkins, Notes on a new collection of fossil Echinoidea from Jamaica. Geol. Mag., vol. 61, pp. 312–324, plate 18. 1924.

[3] W. H. Dall, A gigantic fossil *Lucina.* Nautilus, vol. 15, pp. 40–42. 1901. Synopsis of the Lucinacea and of the American species. Proc. U. S. Nat. Mus., vol. 23, pp. 779–833, plates 39 to 42. 1901. (See pp. 829–830, plate 42, fig. 1.)

a cast from a locality near Jackson Town in the parish of Trelawny. At places flint-bearing, chalky, and globigerinal beds, called Montpelier beds by Hill, lie below these shallow-water middle Oligocene deposits. According to Dr. Matley's field work, this type of beds does not lie at a definite stratigraphic level, but seems to be a relatively deep-water facies interfingering with shallow-water, more massive limestone containing mollusks and large Foraminifera.

The upper part of the White Limestone contains Foraminifera of the genus *Sorites*. It seems to be of the same age as upper Oligocene or lower Miocene (Chattian or Aquitanian) limestone in the island of Anguilla and elsewhere.

MIOCENE.

At places later limestones and marls, called coastal limestones by Matley and a variety of names by Hill, overlie the White Limestone along or near the coast. Their age ranges from Miocene to Quaternary.

A limestone at May Pen, in the parish of Clarendon, carries *Orthaulax aguadillensis* Maury, an upper Oligocene and lower Miocene fossil, and a large oyster similar to *Ostrea cahobasensis* Pilsbry and Brown, a lower Miocene species. According to this evidence the limestone at May Pen is lower Miocene (Burdigalian).

The deposits called Bowden beds and Bowden marl by earlier writers, and here called the Bowden formation, are middle Miocene (Helvetian). The Bowden mollusks are described in this report.

PLIOCENE.

Some of the coastal limestones may be Pliocene, but they have not been adequately studied. Others that contain living species of mollusks and corals probably are Quaternary.

BOWDEN FORMATION.

SOURCE OF DATA.

I regret that I have not visited Bowden. The following account is taken from the descriptions of Sawkins (1896, p. 46),[1] Simpson (1894, p. 433), Hill (1899, pp. 82–84), and Henderson and Simpson (U. S. Geological Survey record book of localities of Tertiary invertebrate fossils, station 2580), supplemented by oral information from Henderson.

NAME, TYPE LOCALITY, AND DISTRIBUTION.

The name "Bowden series" was first used by Sawkins in 1869 (p. 44). This name was modified to "Bowden beds" and "Bowden formation" by Hill (1899, pp. 9–13, 82–84, 145–152). Later writers have followed Dall (1903, p. 1580) in calling these deposits the "Bowden marl." As they consist of different kinds of rock forming a mapable unit, they are here called the Bowden formation.

The type locality of the Bowden formation is at Bowden, on the east side of Port Morant, in the parish of St. Thomas, lying on the south coast of Jamaica near its eastern end. The beds crop out on the slope of the hills facing the bay. At the time when Henderson and Simpson collected there (1894), the best exposure was in a road-cut about 100 yards up the bay from a pier used by the United Fruit Company. This road-cut was at the foot of a hill on which stood a house occupied by Capt. L. D. Baker, an official of the company.

Hill's map shows deposits of the Bowden formation east and west of the type locality and on the north coast east of Buff Bay, where a Bowden coral was collected (Hill, 1899, pp. 84, 149). Detailed field work may reveal other areas.

LITHOLOGY, STRUCTURE, AND THICKNESS.

At the type locality a bed of imperfectly consolidated gravel consisting of small pebbles and grains of igneous rocks, limestone, and other sorts of rock in a marly matrix crops out in the road-cut for a distance of several hundred feet along the bay. This bed, which is not more than 2 or 3 feet thick, contains perfectly preserved fossils, and, so far as known, has furnished all the fossils collected at Bowden. Collectors usually shoveled the gravel and fossils into barrels, a method of collecting that furnished an unusually large number of small specimens. The gravel probably lies at the base of the forma-

[1] See reference to publications in footnote, page 4, and in list on pages 10–12.

tion, but the underlying deposits are not exposed. Overlying the gravel are harder beds of earthy limestone and marl containing casts and impressions of fossils. Farther up the hill, which rises about 300 feet above the bay, are beds of marl, clay, and sandstone. Dr. Matley discovered poorly preserved plant remains in these beds. The beds dip 10° or less south-southeastward. The total thickness of the formation as exposed at the type locality is about 250 feet.

STRATIGRAPHIC RELATIONS.

Although the contact with the underlying deposits is not exposed at the type locality, the Bowden formation clearly is a fringing coastal deposit of relatively small extent overlying the White Limestone. According to Hill (1899, p. 83), the position of the Bowden formation above the Yellow Limestone is "fairly well revealed" along the road from Bath to Bowden, but no description is given of the contact with the White Limestone. No information is available concerning the relations to overlying beds.

FOSSILS.

Cushman[1] has described 30 species and subspecies of Foraminifera from the Bowden formation. Large species of *Haplostiche, Cristellaria,* and *Gypsina* are most abundant. Countless specimens representing these genera drop out of the apertures of small gastropods. Canu and Bassler[2] have described 17 species and subspecies of Bowden Bryozoa. Vaughan has described the Bowden corals, but his report has not been published. In 1919 he listed 17 species and described some of them.[3]

Mollusks are so abundant that their description has lagged behind the other fossils. Fully 600 species are represented in the collections examined for this report. Some of the species are represented by hundreds of specimens. This report describes 185 species and subspecies of bivalves and 20 species and subspecies of scaphopods.

AGE.

The age of the Bowden formation, the relation of its mollusks to Miocene mollusks in other parts of the world, and their ecologic significance will be fully discussed later. I wish to record here the bare

[1] J. A. Cushman, Fossil Foraminifera from the West Indies. Carnegie Inst. Wash. Pub. No. 291, pp. 23–71, 15 plates, 8 text-figs. 1919.

[2] Ferdinand Canu and R. S. Bassler, Fossil Bryozoa from the West Indies. Carnegie Inst. Wash. Pub. No. 291, pp. 75–102, 7 plates. 1919.

[3] T. W. Vaughan, Fossil corals from Central America, Cuba, and Porto Rico, with an account of the American Tertiary, Pleistocene, and Recent coral reefs. Bull. U. S. Nat. Mus. 103, pp. 189–524, plates 68 to 152, text-figs. 4 to 25. 1919. (See p. 212.)

conclusion that the Bowden formation is of middle Miocene (Helvetian) age. It approximately is the equivalent of the Gurabo formation of the Dominican Republic and the Gatun formation of Panama and Costa Rica. Many of its mollusks are similar to species from the Helvetian deposits of the Piedmont basin of Italy.

PREVIOUS REPORTS.

The Bowden formation is not fully described in the report of the official survey of Jamaica published in 1869. Sawkins mentions these deposits in the description of the eastern part of the parish of St. Thomas (pp. 44, 46). In this report the Bowden formation is confused with the middle Eocene Yellow Limestone. Probably all the Miocene mollusks listed on page 152 and on pages 336–339 of Appendix V are Bowden fossils, except "*Cerithium giganteum*" and "*Nerita schmideliana,*" which clearly represent Yellow Limestone fossils. "*Placuna sinuosa*" may refer to a Bowden *Anomia*-like mollusk, perhaps *Placunanomia,* or may refer to a *Carolia* from the Yellow Limestone. This correlation of the Bowden formation with the Yellow Limestone, which resulted in considering the Yellow Limestone Miocene, is evident in the discussion of the fossils by Robert Etheridge in Appendix V (pp. 307, 311–312, 319–329). Hill corrected this mistake (pp. 9–13), and more fully described the Bowden formation (pp. 82–84) and its fossils (pp. 145–152).

During the official survey Lucas Barrett, who was director until his untimely death in the field, sent to the British Museum a collection of Miocene fossils. J. Carrick Moore discussed the significance of these fossils in a paper read before the Geological Society of London in 1863[1] and compared them with some Miocene fossils discovered by Colonel Heneken in 1849 in the Dominican Republic ("San Domingo"). The mollusks in this collection from Jamaica were examined by R. J. Lechmere Guppy, the pioneer investigator of West Indian fossils, while he was in London in 1865, and a paper describing them was published in 1866. Although the collector left no record of the locality, there is no reasonable doubt that these fossils were collected at Bowden. All the species described by Guppy are Bowden species and such perfectly preserved Miocene shells have never been discovered at any other locality in Jamaica. On page 46 of the official survey report, Sawkins states that at Bowden there are "beds of the most perfect Tertiary shells yet found on the island."

[1] J. Carrick Moore, On some Tertiary shells from Jamaica. Quart. Jour. Geol. Soc. London, vol. 19, pp. 510–513. 1863.

No other locality than "Miocene, Jamaica," is given by Guppy in his later papers listed on the following pages. Probably all the specimens from Jamaica described by Guppy in these later papers were sent to him by Mr. Henry Vendryes of Kingston, who informed Hill (p. 147) that they were collected at Bowden.

The following is a chronologic list of reports describing Bowden mollusks:

1866. Guppy, R. J. Lechmere. On the Tertiary Mollusca of Jamaica. Quart. Jour. Geol. Soc. London, vol. 22, pp. 281–295, plates 16–18.

Contains descriptions and figures of 27 new species and brief descriptions of, or references to, 34 previously described species, 12 of which are figured. Specimens of 23 of the new species in the Guppy collection at the United States National Museum are labeled types, although the actual types are in the British Museum.

1866. Guppy, R. J. Lechmere. On the relations of the Tertiary formations of the West Indies. Quart. Jour. Geol. Soc. London, vol. 22, pp. 570–590, plate 26, 3 text figs.

Contains list (p. 575) of 2 new species and 1 previously described species from the "Miocene of Jamaica." On later pages (580–581) the new species are described and figured. Jamaica is not the type locality of these new species.

1867. Guppy, R. J. Lechmere. Notes on West Indian geology, with remarks on the existence of an Atlantis in the early Tertiary period; and descriptions of some new fossils from the Caribbean Miocene. Geol. Mag., vol. 4, pp. 496–501, 6 text-figs.

Contains descriptions and figures of 2 new species from the "Upper Miocene of Jamaica." The types are in the Guppy collection at the United States National Museum.

1867. Guppy, R. J. Lechmere. On the Tertiary fossils of the West Indies with especial reference to the classification of the Kainozoic rocks of Trinidad. Proc. Sci. Assoc. Trinidad, pt. 3, pp. 145–176. Reprint in Bull. Amer. Paleontology, vol. 8, pp. 172–203 (pp. 24–55 of Bull. 35). 1921.

List (pp. 155–164) gives 67 species of mollusks from the "upper Miocene of Jamaica." There are notes on one of these species (p. 171).

1873. Guppy, R. J. Lechmere. On some new Tertiary fossils from Jamaica. Proc. Sci. Assoc. Trinidad, vol. 2, no. 2, pt. 10, pp. 72–88, plates 1, 2. Reprint in Bull. Amer. Paleontology, vol. 8, pp. 204–220 (pp. 56–72 of Bull. 35). 1921.

Contains descriptions of 20 new species, 17 of which are figured, and descriptions of, or references to, 16 previously described species, 2 of which are figured. The types of the new species are in the Guppy collection at the United States National Museum. According to Harris (Bull. Amer. Paleontology, vol. 8, footnotes on pp. 206–213, 215, 217, 218, 1921), the plate references in this paper refer to the succeeding paper, but an original copy of vol. 2, no. 2, pt. 10 of the Proceedings of the Scientific Association of Trinidad, December 1873, in the library of the United States Geological Survey contains the plates referred to in the paper.

1874. GUPPY, R. J. LECHMERE. On the West Indian Tertiary fossils. Geol. Mag., decade 2, vol. 1, pp. 404–411; 433–446, plates 16 to 18.

Contains redescriptions of 18 of the new species described in the precceding paper, 17 of which are figured, and brief descriptions of, or references to, 6 of the other species considered in the preceding paper, 2 of which are figured. Also contains figures of the other 2 new species described in the preceding paper. They are again described in the succeeding paper. List (pp. 437–443) gives 99 species of mollusks from the "Miocene of Jamaica."

1875. GUPPY, R. J. LECHMERE. Supplement to the paper on West Indian Tertiary fossils. Geol. Mag., decade 2, vol. 2, pp. 41–42.

Contains redescriptions of the 2 new species described in 1873 and not redescribed in 1874.

1882. GUPPY, R. J. LECHMERE. On the Recent and Tertiary species of *Leda* and *Nucula* found in the West Indies, with notices of Westindian shells. Proc. Sci. Assoc. Trinidad, vol. 2, no. 4, part 12 (Dec. 1881), pp. 168–180, plate 7. Reprint in Bull. Amer. Paleontology, vol. 8, pp. 237–249, plate 9 (pp. 89–101, plate 5 of Bull. 35). 1921.

Contains descriptions and figures of 3 new species and descriptions of 3 previously described species, 2 of which are figured, from the "Miocene of Jamaica." The types of the new species are in the Guppy collection at the United States National Museum.

1890–1903. DALL, WILLIAM HEALY. Contributions to the Tertiary fauna of Florida, with especial reference to the Miocene silex-beds of Tampa and the Pliocene beds of the Caloosahatchie River. Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3; part 1, pp. 1–200, plates 1 to 12, 1890; part 2, pp. 201–473, map, plates 13 to 22, 1892; part 3, pp. 483–570, 1895; part 4, pp. I-VIII, 571–947, plates 23–35, 1898; part 5, pp. 949–1218, plates 36–47, 1900; part 6, pp. I–XIV, 1219–1654, plates 48–60, 1903. (The following was added to the title of parts 4 to 6: "Including in many cases a complete revision of the generic groups treated of and their American Tertiary species.")

Parts 1 and 2 contain brief descriptions of, or references to, 11 previously described species of gastropods from the "Miocene of Bowden, Jamaica." Parts 4 to 6 contain descriptions of 58 new species of pelecypods, 50 of which are figured; descriptions and figures of 3 other new species reported from Bowden, although the type locality is elsewhere; brief descriptions of, or references to, 42 previously described species and 4 indeterminable species. The locality is given as the "Oligocene of Bowden, Jamaica." Part 6 contains (pp. 1580–1588) a discussion of the fauna and a list of 292 additional species of gastropods, many of which are not named, 10 species of scaphopods, and 12 additional species of pelecypods, making a total of 432 species described or listed. The types of the new species are in the United States National Museum.

1894. SIMPSON, CHARLES TORREY. Distribution of the land and fresh-water mollusks of the West-Indian region, and their evidence with regard to past changes of land and sea. Proc. U. S. Nat. Mus., vol. 17, pp. 423–450, plate 16.

Contains descriptions and figures of 3 new species of land snails from the "Miocene beds at Bowden." The types are in the United States National Museum. These shells may be the remains of living shells that fell into openings in the ground and thus were collected with the fossil material.

1896. Guppy, R. J. Lechmere, and William Healy Dall. Descriptions of Tertiary fossils from the Antillean region. Proc. U. S. Nat. Mus., vol. 19, pp. 303–331, plates 27 to 30. 1896.

Contains descriptions and figures of 33 new species, brief descriptions of, or references to, 20 previously described species and 1 indeterminable species from the "Oligocene of Jamaica." The types of the new species are in the United States National Museum.

1904. Grabau, W. Amadeus. Phylogeny of *Fusus* and its allies. Smithsonian Misc. Coll., vol. 44, No. 1417, 192 pp., 18 plates, 22 text-figs.

Contains description of a species from Bowden.

1907. Smith, Burnett. A contribution to the morphology of *Pyrula*. Proc. Acad. Nat. Sci. Philadelphia, vol. 59, pp. 208–219, plate 17, 2 text-figs.

Contains description and figures of a new species from Bowden. The type is in the Philadelphia Academy of Natural Sciences.

1911. Pilsbry, Henry A. Scaphopods of the Jamaican Oligocene and Costa Rican Pliocene. Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 165–169, 5 text-figs.

Contains descriptions of 4 new species, 3 of which are figured, 2 indeterminable species, and references to 3 previously described species from Bowden. The types of the new species are in the Philadelphia Academy of Natural Sciences.

1913. Cossmann, M. Étude comparative de fossiles miocéniques recueillis à la Martinique et à l'Isthme de Panama. Jour. de Conch., vol. 61, pp. 1–64, plates 1 to 5.

Contains references to and figures of 3 species of gastropods from Bowden.

1917. Pilsbry, H. A., and C. W. Johnson. New Mollusca of the Santo Domingo Oligocene. Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 150–202.

Contains description (p. 194) of 1 new species from Bowden. The type is in the Philadelphia Academy of Natural Sciences.

1922. Pilsbry, Henry A. Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo. Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 305–435, plates 16 to 47, 48 text-figs.

Contains descriptions (pp. 343, 360, 365) and figures of 3 new subspecies from Bowden, and a figure of the new species described in the preceding paper. The types are in the Philadelphia Academy of Natural Sciences.

DESCRIPTION OF SPECIES.

Class PELECYPODA.

Superfamily NUCULACEA.

Family NUCULIDAE.

Genus NUCULA Lamarck.

Subgenus NUCULA s. s.

Section NUCULA s. s.

Lamarck, 1799, Mémoires de la Société d'Histoire Naturelle de Paris, p. 87.

Type (*by monotypy*).—*Arca nuculeus* Linné. Recent, seas of Europe.

The following is a description of the section *Nucula* s. s.:

Shell small, trigonal, inequilateral, anterior end longer than posterior; interior nacreous; area behind umbo slightly or strongly depressed; surface smooth or sculptured with fine radials or concentric rugae, or both; chondrophore narrow, oblique; hinge consisting of an anterior and posterior series of chevron-shaped teeth, the anterior longer; lower margin of valve usually finely fluted.

The distribution of the Tertiary and living species of *Nucula* is virtually cosmopolitan. They are more abundant and reach a larger size in cool water.

Nucula (Nucula) morantensis, new species.

(Plate 1, Figure 1.)

The following is a description of this species:

Shell small, subtrigonal, moderately inequilateral, moderately inflated; area behind umbo definitely depressed, relatively large, cordate; sculpture consisting of coarse concentric rugae and fine radial threads between the rugae; sculpture of posterior depressed area similar to that of remainder of shell, but less distinct; hinge heavy for size of shell, anterior series slightly arcuate, consisting of about 10 teeth, posterior series shorter, straight, including about 6 teeth; inner margin of valve finely fluted.

Length 4.8 mm.; height 4 mm.; diameter (left valve) 0.9 mm.

The relatively strong sculpture and depressed lunule-like escutcheon are characteristic features of this species. It is larger than *N. tenuisculpta* Gabb from the Baitoa and Cercado formations of the Dominican Republic, and has coarser sculpture. It resembles *N. cahuitensis* Olsson,[1] a Miocene species from Costa Rica, in outline, but has coarser sculpture, larger escutcheon, and no lunule. The Costa Rican species closely resembles *N. vieta* Guppy, described from deposits probably of Miocene age at Matura, Trinidad.

The holotype of *N. morantensis* has both valves in attached position. None of the unattached valves is perfect, and therefore an interior view is not figured.

[1] Comparison based on figures.

Type material.—Holotype (both valves in attached position, U. S. Nat. Mus. No. 352727).

Section NUCOLOPSIS, new section.

Type.—Nucula (Nuculopsis) hilli new species.

The following is a description of the section *Nuculopsis:*

Shell medium-sized, subelliptical, inequilateral; sculpture consisting of strong concentric rugae; chondrophore long, narrow, oblique, deeply excavated; anterior series of teeth more than twice as long as posterior series; anterior teeth reduced in size toward chondrophore, posterior teeth not reduced; interior of valve subnacreous; lower inner margin of valve smooth.

The outline and sculpture of *Nuculopsis* and *Nucula* s. s. are strikingly different. The chondrophore is more detached from the anterior series of teeth than in *Nucula* s. s., and the anterior teeth above the chondrophore are much smaller. Externally *Nuculopsis* resembles some of the subelliptical species of the genus *Tindaria,* but the ligament of *Tindaria* is wholly external. Apparently no similar Tertiary or living species has been described.

Nucula (Nuculopsis) hilli, new species.

(Plate 1, Figures 2, 3.)

The following is a description of this species:

Shell thin, polished; sculpture consisting of regular concentric rugae, crowded and less prominent on dorsal half of shell, umbo almost smooth; chondrophore relatively large, elongate, subtriangular, its axis oblique and curved, deeply set, placed immediately in front of umbo; teeth short, anterior series longer, moderately curved, including 15 or 16 teeth progressively reduced in size toward the chondrophore and continuing almost to tip of umbo, the last few teeth lying along upper anterior margin of chondrophore; posterior series short, straight or slightly concave, consisting of 5 or 6 teeth of virtually the same size, the series terminating abruptly at the chondrophore.

Length 8.9 mm.; height 6.9 mm.; diameter (right valve) 1.9 mm.

The living West Indian species *N. cymella* Dall has similar concentric sculpture and smooth inner ventral margin, but in other features is a *Nucula* s. s. Externally *N. hilli* resembles subovate or subelliptical species of the genus *Tindaria,* such as *T. smithii* Dall and *T. cytherea* Dall, living West Indian species. *N. hilli* is not so strongly inflated as these species of *Tindaria* and has an entirely internal ligament.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352728).

Family LEDIDAE.

Genus LEDA Schumacher.

Section LEDA s. s.

Schumacher, 1817, Essai d'un Nouveau Système des Habitations des Vers Testacés, pp. 55, 172.

Type (*by monotypy*).—*Arca rostrata* Chemnitz (=*Mya pernula* Müller). Recent, seas of Europe.

The following is a description of the section *Leda* s. s.:

Shell medium-sized, elongate, inequilateral, posterior end rostrate and slightly gaping, rostrum bicarinate; lunule distinct; sculpture consisting of concentric rugae on dorsal half of valve, replaced by incrementals on ventral half; hinge consisting of an anterior and posterior series of chevron-shaped teeth, posterior series almost twice as long as anterior series; chondrophore small, deep, triangular; pallial sinus shallow, its apex narrowly U-shaped.

Most of the living species of the section *Leda* s. s. live in the cool seas. There are no species in the Bowden formation.

Section SACCELLA, new name.

Ledina, Sacco, December 1898, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, pt. 26, p. 53.

Type (*by original designation*).—*Arca fragilis* Chemnitz (=*Leda commutata* Philippi). Miocene to Recent, Mediterranean Sea.

Not *Ledina* Dall, April 1898 (Transactions Wagner Free Institute of Science of Philadelphia, vol. 3, pt. 4, p. 580).

Type (*by original designation*).—*Leda eborea* Conrad 1860 (not *L. eborea* Conrad 1846)=*L. smirna* Dall. Eocene, Gulf States of the United States).

The following is a desciption of the section *Saccella*:

Shell small, high, slightly inequilateral, posterior end rostrate, rostrum sharply pointed and unicarinate; a shallow groove extends from the umbo to the ventral margin at both ends of the valve; sculpture consisting of strong concentric rugae; hinge like *Leda* s. s., but the anterior and posterior series of teeth are approximately equal in length; apex of pallial sinus broadly U-shaped.

Saccella resembles the section *Lembulus* Risso,[1] but has a narrower and shallower posterior groove, and concentric instead of diagonal sculpture. There are no American late Tertiary or living species of *Lembulus*. The geographic distribution and difference in sculpture warrant the renaming of Sacco's section, although the hinge and pallial sinus of *Lembulus* and *Saccella* are similar.

Many species of *Saccella* have been described from Tertiary deposits. Most of the Tertiary Ledas from tropical America are Saccellas. Other species occur in the subtropical and temperate

[1] *Type* (by subsequent designation, Gray, 1847).—*Lembulus rossianus* Risso (= *Arca pella* Linné). Recent, Mediterranean Sea.

faunas of Europe, America, and elsewhere. The living species are widely distributed.

Key to the Bowden species of Saccella.

Sculpture consisting of concentric rugae.
  Length of adult shell exceeding 6 mm., sculpture coarse.....*L.* (*S.*) *peltella.*
  Length of adult shell not exceeding 6 mm., sculpture fine.....*L.* (*S.*) *subcerata.*
Sculpture consisting of concentric rugae and fine, obscure radial threads in the interspaces.....*L.* (*S.*) *indigena.*

Leda (Saccella) peltella Dall.

(Plate 1, Figures 4, 5.)

Leda peltella Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 579 (name only), plate 32, fig. 5. Not Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 329, plate 52, fig. 9 (=*L. extricata* Pilsbry and Johnson). Not Hubbard, 1921, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, pt. 2, p. 104, plate 17, fig. 6, New York Acad. Sci.

The following is a description of this species:

Shell medium-sized, plump; lunule narrow, sculptured with coarse threads not continuous with the concentric rugae; a faint groove usually lies in front of the rostral ridge; on some shells an obscure groove extends from the umbo to the ventral margin at the anterior end of the shell; sculpture consisting of regular, closely set concentric rugae, extending across the rostral ridge and escutcheon, terminating at the edge of the narrow lunule; about 20 teeth lie in front of, and 15 behind the small chondrophore.

Length 8.8 mm.; height 5.8 mm.; diameter (right valve) 2.4 mm.

Type locality.—Bowden, Jamaica.

The absence of concentric rugae on the lunule is a characteristic feature of this species, which is the most abundant *Leda.* Most of the shells are high, but some are relatively long. The posterior groove is not so strong as in the figure given by Dall. The anterior groove usually is indicated only by a slight displacement of the rugae.

Dall considered this species the same as *Leda acuta* Gabb, a Miocene species from the Dominican Republic, and substituted the name *peltella* for the preoccupied name *acuta,* but figured a Bowden shell and designated a Bowden shell as type material. Pilsbry and Johnson have described the Dominican species as *L. extricata. L. peltella* closely resembles *L. extricata,* but is less elongate and more inflated, and has a different lunule and escutcheon.

The *Leda* from the Quebradillas limestone of Porto Rico described by Hubbard as *L. peltella* is larger and more elongate than Bowden specimens, and its posterior end is less distinctly grooved.[1]

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135753).

[1] Comparison based on figures.

Leda (Saccella) subcerata, new species.

(Plate 1, Figures 6, 7.)

The following is a description of this species:

Shell small, polished, elongate, virtually equilateral; rostrum blunt, slightly recurved; umbos full, strongly incurved; escutcheon poorly defined, bounded by a low rounded ridge; area in front of umbo slightly depressed, but not forming a lunule; sculpture consisting of fine rugae, more sharply sculptured and crowded on ventral half of shell, continuous across depressed areas, both before and behind umbo; chondrophore relatively narrow and long; about 16 teeth in anterior series and 13 in posterior; chondrophore very small, deeply inset; muscle scars relatively large.

Length 5.8 mm.; height 3.4 mm.; diameter (right valve) 1.3 mm.

The elongate equilateral outline, polished surface, and ventral crowding of the rugae are characteristic features of this species. It closely resembles the living West Indian *L. cerata* Dall, but is smaller, and has fuller umbos and more strongly upturned rostrum. It also resembles *L. vitrea* d'Orbigny, but d'Orbigny's species has not been certainly identified.

Three of the 4 cotypes of *L. perlepida* Guppy (U. S. Nat. Mus. No. 115557), from beds probably of Miocene age at Matura, Trinidad, are young shells that are virtually indistinguishable from young, unusually high shells of *L. subcerata.* The other shell, which was figured, has concentric waves in addition to rugae.

Type material.—Holotype (right valve, U. S. Nat. Mus. 352729).

Leda (Saccella) indigena Dall.

(Plate 1, Figures 8 to 10.)

Leda bisulcata Guppy, 1867, Geol. Mag. decade 1, vol. 4, pp. 500–501, fig. 2. Guppy, 1874, Geol. Mag. decade 2, vol. 1, p. 442 (list). Guppy, 1882, Proc. Sci. Assoc. Trinidad, part 12, p. 173, plate 7, fig. 7. Not *L. bisulcata* Meek and Hayden, 1861.

Leda indigena Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 579 (name only).

The following is the original description of *Leda bisulcata* Guppy:

Shell ovately trigonal, with numerous concentric ribs narrower than their interstices; with a somewhat sinuous elevated ridge running from the umbo to the pointed rostrum behind; rounded anteriorly with a round groove running from the umbo to the ventral margin near the anterior angle. Umbones close; posterior dorsal area flat, sloping, striate continuously with the ribs of the disc; no very distinct anterior area. Teeth very prominent.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell small, moderately inequilateral; posterior end sharply rostrate, rostrum slightly recurved; lunule not differentiated, represented by a slightly depressed narrow zone; escutcheon sharply differentiated, broad, extending to tip of rostrum, bounded by a strong ridge; immediately in front of the

rostral ridge a shallow groove extends from the umbo toward the ventral margin; near the anterior end a shallow groove extends from the umbo to the ventral margin; sculpture concentric and radial, concentric sculpture consisting of closely-set rugae, equally strong over entire valve and persisting across the rostral ridge and escutcheon; radial sculpture consisting of fine threads confined to the interspaces, strongest near the grooves; about 15 teeth lie behind, and 16 teeth in front of the deeply set small triangular chondrophore.

Length 6.5 mm.; height 3.8 mm.; diameter (left valve) 1.5 mm.

This abundant species is recognized by the pointed slightly recurved rostrum; sharp posterior ridge; broad, long escutcheon that is conspicuously sculptured by the concentric rugae; and fine radial sculpture.

L. indigena resembles *L. acuta* (Conrad) which ranges from the upper Miocene to the Recent and also has a wide geographical range. The Bowden species is smaller, less elongate, and has a recurved rostrum and more constantly fine concentric sculpture than *L. acuta*. *L. dodona* Dall, from the Oak Grove sand of Florida, belongs to the same group. It has very coarse concentric rugae and an almost smooth escutcheon. A species from the Chipola formation of Florida, *L. trochilia* Dall, has wide spaces between the discontinuous and irregular rugae, and no rugae on the rostral ridge. None of these species has the radial threads of *L. indigena*. *L. davilae* Olsson,[1] a Miocene species from Costa Rica and Panama, has similar radial threads, but is higher than *L. indigena*.

Type material.—3 cotypes ("types" of *L. bisulcata* Guppy, U. S. Nat. Mus. No. 115553).

Section JUPITERIA Bellardi.

Bellardi, 1875, Monografia della Nuculidi Trovate Finora nei Terreni Terziari del Piemonte e della Liguria, p. 20.

Type (by subsequent designation, Dall, 1898).—Nucula concava Bronn. Pliocene, Italy.

The following is a description of the section *Jupiteria*:

Shell small, corbuloid, strongly inflated, subequilateral, bluntly rostrate, rostrum barely ridged; area behind umbo flattened but not depressed; sculpture consisting of obscure concentric rugae; hinge consisting of an anterior and posterior series of chevron-shaped teeth, approximately equal in length; chondrophore small, triangular, deep; pallial sinus shallow, its apex broadly U-shaped.

The corbuloid outline, blunt and barely ridged rostrum, and shallow sinus separate this section from the other sections of *Leda*. Externally, *Jupiteria* closely resembles rostrate species of *Tindaria*.

The Bowden species described on the following pages are the only known American Tertiary Ledas similar to *Leda concava* (Bronn).

[1] Comparison based on figures.

Several Miocene species have been described from the Mediterranean region, and 2 species are recorded from lower Oligocene deposits in Germany. There are no living European species of *Jupiteria,* but it is represented in the Gulf of Mexico by *Leda solidifacta* Dall. This section of *Leda* is one of many groups that lived in West Indian and Mediterranean waters during Miocene time but now are restricted to West Indian or adjacent waters.

Key to the Bowden species of Jupiteria.

Length of adult shell exceeding 5 mm.....*L.* (*J.*) *bowdenesis*
Shell relatively high..... *L.* (*J.*) *bowdenensis bowdenensis*
Shell elongate..... *L.* (*J.*) *bowdenensis subtumida*
Length of adult shell not exceeding 5 mm..... *L.* (*J.*) *duerdeni*

Leda (Jupiteria) bowdenensis bowdenensis, new species and subspecies.

(Plate 1, Figures 11, 12.)

The following is a description of this subspecies:

Shell small, elongate subtrigonal; umbos high, very full, strongly incurved; area behind umbo flattened; posterior ridge low, broad; sculpture consisting of irregularly spaced fine concentric striae, absent on umbos and in area within posterior ridge, coinciding with irregularly spaced growth lines on ventral half of shell; chondrophore triangular, relatively broad; about 19 teeth in the slightly convex anterior series and about 13 teeth in the concave posterior series, median teeth small and obscure; muscle scars faint, relatively large.

Length 6.2 mm.; height 4.5 mm.; diameter (right valve) 1.9 mm.

This subspecies is similar to *L. concava* (Bronn), the type of the section, from the Plaisancian of the Piedmont basin, northern Italy.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352731).

Leda (Jupiteria) bowdenensis subtumida, new subspecies.

(Plate 1, Figures 13, 14.)

The following is a description of this subspecies:

Shell resembling *L. bowdenensis bowdenensis,* but more elongate and slightly less inflated; umbos lower and less full; ventral margin less curved; sculpture coarser and more irregular; chondrophore broader; hinge having about 13 teeth in each series; anterior series more convex and posterior less concave than in *L.* (*J.*) *bowdenensis bowdenensis.*

Length 6.5 mm.; height 4 mm.; diameter (right valve) 1.7 mm.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352732).

Leda (Jupiteria) duerdeni, new species.

(Plate 1, Figures 15, 16.)

The following is a description of this species:

Shell small, polished, rounded triangular, strongly inflated; umbo high, full; area behind umbo distinctly flattened; rostral ridge low, broad; sculpture consisting of fine evenly spaced concentric rugae, absent on top

of umbo and in area bounded by rostral ridge, sculpture on some shells absent on posterior half or entire surface of shell; chondrophore large, triangular, lying below and just in front of tip of umbo; anterior series of teeth including about 13, posterior series 16.

Length 4.9 mm.; height 3.4 mm.; diameter (left valve) 0.9 mm.

L. duerdeni is smaller and higher than *L. bowdenensis* and has a shorter and more acute rostrum, stronger ridge, more regular and more delicate sculpture, larger chondrophore, and heavier hinge. Externally it resembles the rostrate *Tindarias,* for which Verrill and Bush[1] proposed the name *Tindariopsis.*

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352733).

Section PSEUDOPORTLANDIA, new section.

Type.—Leda clara Guppy. Miocene, Jamaica.

The following is a description of the section *Pseudoportlandia*:

Shell heavy, medium sized, moderately inflated, upper posterior margin bluntly rostrate, lower posterior margin truncated; sculpture consisting of obscure striae; hinge consisting of an anterior and posterior series of heavy chevron-shaped teeth, anterior series slightly longer; chondrophore wide, triangular, moderately deep; pallial sinus apparently shallow.

In outline *Leda clara* is remarkably similar on a small scale to *Yoldia glacialis* (Gray), the type of the section *Portlandia* Mörch, which is restricted to boreal waters. The Bowden species has a relatively heavier hinge, much shallower chondrophore, and apparently a shallower pallial sinus. The outline, heavy hinge, and wide chondrophore distinguish *Pseudoportlandia* from other sections of *Leda.* In many features *Pseudoportlandia* is intermediate between *Leda* and *Yoldia,* but the rostrum and apparent shallow sinus indicate that it more closely resembles *Leda.*

The following Bowden species and a similar undescribed species from the Gurabo formation of the Dominican Republic are the only known species of *Pseudoportlandia.*

Leda (Pseudoportlandia) clara Guppy.

(Plate 1, Figures 17 to 19.)

Leda clara Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, no. 2, p. 87, plate 2, figs. 1, 1*a*. Guppy, 1874, Geol. Mag. decade 2, vol. 1, p. 442 (list), plate 17, figs. 1, 1*a*. Guppy, 1875, Geol. Mag. decade 2, vol. 2, p. 42. Guppy, 1882, Proc. Sci. Assoc. Trinidad, part 12, p. 172, plate 7, fig. 4.

The following is the description of this species published by Guppy in 1875:

Subelliptical, lanceolate, nearly equilateral, somewhat but not extremely rostrated. Disk smooth, shining; valve with a few fine, close, regular concentric riblets perceptible near the anterior angle, where an indistinct sulcus runs upwards towards the umbo. No distinct escutcheon. Lunule narrow,

[1] A. H. Verrill, and K. Bush, Amer. Jour. Sci., ser. 4, vol. 3, p. 59. 1897

indistinctly defined. Umbos prominent. Ventral margin slightly angulated at about a third of its length from the posterior point, where an obscure carina runs to the margin from the umbo.

Length 12 mm.; height 6 mm.; thickness about 4 mm.

Type locality.—Jamaica.

The following supplements Guppy's description of this species:

Shell medium-sized, heavy, subequilateral; anterior dorsal margin convex, posterior dorsal margin excavated; umbo low, approximately central; lunule not differentiated, represented by a very narrow, slightly flattened area; area behind umbo wider, flattened; rostral ridge lying near dorsal margin, low, broad; ventral third of shell bearing a broad, shallow groove in front of rostrum, the groove very slightly emarginating the truncated posterior margin; sculpture consisting of fine striae, accentuated by irregularly spaced incrementals on ventral half of shell; chondrophore large; anterior series of teeth including about 19 teeth, posterior series 15.

Length 13.5 mm.; height 7.5 mm.; diameter (right valve) 2.3 mm.

This species is the largest Bowden *Leda*. Young shells are only slightly truncated below the blunt rostrum, but on full-grown shells the truncation is prominent. The pallial line is obscure on all valves, but on some there appears to be a shallow sinus.

A fragment of a very similar species was collected from the Gurabo formation (station 8528) in the Dominican Republic. The Dominican shell is slightly larger and has stronger sculpture.

Type material.—4 cotypes (U. S. Nat. Mus. No. 115558).

Genus YOLDIA Möller.

Section YOLDIA s. s.

Möller, 1842, Index Molluscorum Groenlandiae, p. 18.

Type (by subsequent designation).—*Nucula arctica* Möller not Gray (=*Nucula myalis* Couthouy). Recent, northern seas of Europe.

The following is a description of the section *Yoldia* s. s.:

Shell moderately large, subovate, slightly rostrate; sculpture consisting of growth-lines or concentric striae; hinge consisting of 2 subequal series of small chevron-shaped teeth; chondrophore large, wide, triangular, extending far below the teeth; pallial sinus deep, wide, the apex broadly U-shaped.

There are no Tertiary or living species of *Yoldia* s. s. in tropical America.

Section ORTHOYOLDIA Verrill and Bush.

Verrill and Bush, 1897, American Journal of Science, ser. 4, vol. 3, p. 55.

Type (by original designation).—*Yoldia scapania* Dall. Recent, coast of Brazil.

The following is a description of the section *Orthoyoldia*:

Shell medium-sized, solenoid; sculpture consisting of obscure striae; hinge consisting of 2 series of small chevron-shaped teeth, posterior series longer

than anterior; chondrophore relatively small, wide, triangular; pallial sinus deep, very wide, the apex broadly U-shaped.

In outline *Orthoyoldia* and *Yoldia* s. s. are strikingly different; the disparity in length of the two series of teeth is greater in *Orthoyoldia,* and its chondrophore is not so high. The Bowden species, *Yoldia ovalis* Gabb, has more prominent umbos and more distinct sculpture than the type of the section, but the hinges of the two species are similar.

Orthoyoldia is a tropical and subtropical American group. *Yoldia pasammotaea* Dall, a Claiborne (middle Eocene) species, may be an *Orthoyoldia,* but its hinge is not known. *Yoldia serica* Conrad, an Oligocene species, seems to be an *Orthoyoldia.*

Yoldia (Orthoyoldia) ovalis Gabb.

(Plate 1, Figures 20, 21.)

Yoldia ovalis Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, pp. 255–256.
Pilsbry, 1922, Proc. Acad. Nat. Sci., Philadelphia, vol. 73, p. 402, text fig. 34.

The following is the original description of this species:

Shell small, compressed, subelliptical; beaks slightly in front of middle; hinge line sloping gently, base and ends rounded; surface smooth or bearing a few faint impressed concentric lines on anterior part near base. Length 0.35 inch, width 0.15 inch.

Type locality.—Dominican Republic.

The following is a description of Bowden specimens of this species:

Shell medium-sized, thin, polished, subelliptical, posterior end compressed, umbos low; behind the umbo lies a narrow, slightly depressed area sculptured with relatively coarse, oblique threads and having a heavier thread parallel to and scarcely separated from inner edge of the area; in front of the umbo lies a similar shorter area; sculpture consisting of fine, inconspicuous striae, absent in umbonal and posterior regions, and on some shells entirely absent; chondrophore small, wide; the two series of teeth diverging at a very obtuse angle; about 18 teeth in anterior and 20 in posterior series; anterior teeth larger, in both series the size reduced gradually toward point of divergence; muscle scars obscure; pallial sinus deep, moderately wide.

Length 8.8 mm.; height 5 mm.; diameter (left valve) 1.8 mm.

The depressed areas before and behind the umbo are very narrow. They are more deeply depressed than in specimens from the Gurabo formation of the Dominican Republic. The Dominican specimens have no sculpture except a few low concentric waves in the middle lower part of the shell. Most Bowden specimens have fine striae.

Olsson[1] has described a similar species, *Yoldia bocasensis,* from Miocene beds on Bocas Island, Panama. It apparently is a little more inequilateral. *Y. ovalis* is similar to *Y. solenoides* Dall, a living species from the Gulf of Mexico, but is less elongate, and has a slightly more prominent and acute umbo. The hinges of the two

[1] Comparison based on figures.

species are very similar. In outline *Y. ovalis* closely resembles elongate species of the genus *Malletia.*

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (left valve, Acad. Nat. Sci. Philadelphia No. 3319).

Family MALLETIIDAE.

Genus TINDARIA Bellardi.

Section TINDARIA s. s.

Bellardi, 1875, Monografia della Nuculidi Trovate Finora nei Terreni Terziari del Piemonte e della Liguria, p. 28.

Type (by monotypy).—Tindaria arata Bellardi. Miocene and Pliocene, Italy.

The following is a description of the section *Tindaria* s. s.:

Shell small, veneroid, strongly inflated; umbos full, prosogyrate; sculpture consisting of more or less distinct concentric rugae; ligament external, opisthodetic; hinge uninterrupted below umbo, posterior series strongly curved, anterior series shorter, straighter, and consisting of heavier teeth; pallial sinus moderately deep, the apex V-shaped.

The outline, prosogyrate umbos, and hinge distinguish *Tindaria* from other genera in the family Malletiidae, which is characterized by an external ligament.

Tindaria is one of many genera that lived in the West Indian and Mediterranean regions during Miocene and Pliocene time, but have survived in West Indian and adjacent waters and not in European seas. The following species is the only known American Tertiary species. Miocene deposits have furnished the oldest species on both sides of the Atlantic.

Tindaria (Tindaria) species.

(Plate 1, Figures 22, 23.)

The following is a description of this species:

Shell small, polished, subovate, moderately inequilateral; sculpture consisting of regularly spaced, relatively coarse concentric rugae, absent on umbo and near dorsal margins; ligament external, opisthodetic, the area very narrow and shallow, obscurely truncating upper part of inner posterior teeth; teeth in two series, barely interrupted under the umbo; the convex posterior series of 15 teeth reduced in size toward umbo and the dorsal parts of the 7 inner teeth obscured by immersion of ligament; anterior series slightly concave, including 7 teeth, the outer 5 heavy and the inner 2 abruptly reduced in size; interior of shell polished; anterior muscle scar relatively large, placed under end of hinge; posterior scar and pallial line obscure.

Length 3.5 mm.; height 2.5 mm.; diameter (left valve) 1.2 mm.

The left valve on which this description is based was broken and a piece lost after the description was written. It is smaller and less

elongate than the living West Indian species *T. cytherea* Dall and differs also in hinge characters. The Bowden species more closely resembles *T. panamensis* Dall from the Gulf of Panama, but is shorter and its posterior end is more inflated.

Superfamily ARCAEA.

Family ARCIDAE.

Genus GLYCYMERIS da Costa.

Subgenus GLYCYMERIS s. s.

da Costa, 1778, Historia Naturalis Testaceorum Brittanniae, or the British Conchology, p. 168.

Type (by subsequent designation, Dall, 1898).—Glycymeris orbicularis da Costa (=*Arca glycymeris* Linné). Recent, seas of Europe.

The following is a description of the subgenus *Glycymeris* s. s.:

Shell medium-sized, suborbicular, equilateral; umbos erect; sculpture consisting of radial striae or radial ribs; cardinal area moderately wide, ligament amphidetic; hinge consisting of two series of heavy teeth, outer teeth of both series almost horizontal, inner teeth chevron-shaped, median teeth obliterated by downward extension of cardinal area; inner surface of margin of valve fluted.

Tertiary and living species of *Glycymeris,* also known as *Pectunculus,* are most abundant in tropical and subtropical faunas, but occur in temperate faunas.

Key to the Bowden species of Glycymeris s. s.

Anterior end of shell obliquely truncate, radial sculpture weak....*G. (G.) jamaicensis*
Anterior end of shell not obliquely truncate, radial sculpture strong.
G. (G.) acuticostata plasia

Glycymeris (Glycymeris) jamaicensis Dall.

(Plate 2, Figures 1 to 3.)

Pectunculus pennacea Guppy (not Lamarck), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293.

Pectunculus decussatus Guppy (part, not Linné), 1874, Geol. Mag., decade 2, vol. 1, p. 443 (list).

Glycymeris jamaicensis Dall, 1898, Trans. Wagner Free Inst. Philadelphia, vol. 3, part 4, p. 608. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, pp. 350–351, plate 22, figs. 3, 4. Not Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 345, plate 52, fig. 13 (=*G. diffidentiae* Pilsbry and Johnson).

The following is an extract from the original description of this species:

Shell of moderate size, nearly circular, quite convex, externally sculptured with fine, even, radiating striae, impressed at intervals so as to give the effect of obsolete ribs, which are more apparent on the middle of the shell; on the beaks some of the threads are stronger; umbones low and plump; cardinal area impressed, narrow, short, and smooth; teeth small, uninterrupted, about 24 in all, the line gently arcuate; inner margin fluted, with a slight insinuation near the base in front.

Length 35 mm.; height 33 mm.; diameter 22 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell inflated, umbos low, full; lower two-thirds of anterior slope on adult shells gently keeled; at the anterior margin the keel is the upper termination of a truncation extending obliquely downward; posterior half of ventral margin symmetrically curved; sculpture consisting of many low, inconspicuous radial ribs, narrowing into more prominent threads on umbo and absent in extreme anterior and posterior dorsal regions; fine, equally spaced radial striae and equally fine, but less prominent, concentric striae are superimposed on the ribs and in the narrower interspaces, the two sets of striae producing a minutely cancellate sculpture visible only on unworn valves; cardinal area very narrow; hinge-plate gently and uniformly arched; teeth relatively small, 13 behind and 12 in front of umbo; buttresses of muscle-scars not prominent.

Length 35 mm.; height 34 mm.; diameter (left valve) 11.5 mm.

This species is the most abundant *Glycymeris*. Adult shells are characterized by the anterior keel and anterior truncation. Young shells may readily be distinguished from the other Bowden species by their sculpture.

G. jamaicensis closely resembles the living West Indian species *G. undatus* Linné, but is smaller and has stronger radial ribs on the upper half of the shell. According to Olsson, specimens of *G. jamaicensis* from Costa Rica reach a length of 60 mm. *G. carbasina* Brown and Pilsbry, from the Gatun formation of the Canal Zone, is more circular and has stronger radial sculpture. The species from the Cercado formation of the Dominican Republic (*Axinea pennacea* of Gabb, *Pectuuculus decussatus* of Guppy, and *Glycymeris jamaicensis* of Maury) has been described by Pilsbry and Johnson as *G. diffidentiae*. It is smaller, less conspicuously truncate, and has stronger radial ribs.

Other localities.—Miocene, Curaçao.[1] Gatun formation (middle Miocene), Costa Rica, Panama.

Type material.—10 cotypes (U. S. Nat. Mus. No. 135762).

Glycymeris (Glycymeris) acuticostata plaisa, new subspecies.

(Plate 2, Figures 4, 5.)

Pectunculus acuticostatus Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, 1866. Guppy (part, not Sowerby), 1874, Geol. Mag. decade 2, vol. 1, p. 443 (list).

The following is a description of this subspecies:

Shell medium-sized, moderately inflated, ovate-trigonal; anterior margin extended, subangular; posterior and ventral margins broadly rounded; umbo low; sculpture consisting of about 26 low radial ribs, sharply angular on unworn shells except in extreme anterior and posterior dorsal parts, the flanks of the ribs sloping gently from the angular summit, forming angular interspaces; concentric sculpture consisting of fine, equally spaced threads,

[1] The record of Bowden species from Curaçao probably is incorrect. Specimens in the United States National Museum labeled "Curaçao" seem to be specimens from Bowden. This footnote was added when the report was in page proof.

usually not overriding summits of radials, but conspicuous on their flanks; cardinal area narrow, short, conspicuously marked by ligament grooves diverging from a median vertical line; hinge plate arcuate; teeth small, interrupted medially by the subsidence of the cardinal area, 12 or 13 teeth in each series; inner margin of the valve coarsely fluted.

Length 24 mm.; height 23.8 mm.; diameter (left valve) 6.5 mm.

The low sharply angular ribs and subangular anterior margin are characteristic features. On young shells the irregular outline of the anterior margin is obscure or absent. Young shells apparently belonging to this species have different types of outline and sculpture. Some have the typical somewhat compressed outline and characteristic angular ribs; others are more inflated, and have higher umbos and angular or subangular ribs, separated by definite interspaces. Most of the smallest shells are inflated and have more or less rounded ribs separated by narrower interspaces. The shell of the last group resembles the living West Indian species *G. pectinata* (Gmelin), but have higher umbos and narrower ribs and interspaces.

G. acuticostata plasia closely resembles *G. acuticostata acuticostata,* described by Sowerby from beds in the Dominican Republic that are now known to belong to the Gurabo formation, but the ribs are broader at the base and the interspaces are V-shaped.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352737).

Subgenus GLYCYMERELLA, new subgenus.

Type.—Pectunculus pennacea Lamarck (?=*Arca decussatus* Linné). Recent, West Indies.

The following is a description of the subgenus *Glycymerella:*

Shell medium-sized, suborbicular, slightly inequilateral; umbos inflated, prosogyrate; sculpture consisting of narrow radial ribs, radial striae, and fine concentric threads; cardinal area narrow, excavated; ligament opisthodetic; hinge consisting of two continuous series of chevron-shaped teeth, posterior series convex, anterior series almost straight, upper edge of inner posterior teeth obliterated by ligament; inner margin of valve fluted.

The opisthogyrate umbos, opisthodetic ligament, and correspondingly asymmetric hinge separate *Glycymerella* from *Glycymeris* s. s. *Glycymerella* resembles *Postligita,* a subgenus of *Glycymeris* described by Gardner[1] for a small Upper Cretaceous species, *Glycymeris* (*Postligita*) *wordeni* Gardner. This species and a similar unpublished species from the Upper Cretaceous of Tennessee, *G.* (*P.*) *crenata,* Wade, are small and have only concentric sculpture. The ligament is opisthodetic, like in *Glycymerella,* but the cardinal area is almost vertical and flat, and the ligament grooves are very oblique. The hinge of *Postligita* consists of two uninterrupted series of short teeth; the lower teeth are chevron-shaped and the upper ones are straight; the posterior series is convex and the anterior series concave.

[1] J. A. Gardner, Maryland Geological Survey, Upper Cretaceous, p. 543. 1916.

The hinge of *Glycymerella* with its heavy chevron-shaped teeth is more like that of *Glycymeris* s. s.

The Upper Cretaceous genus *Protarca* recently described by Stephenson[1] (type, *Protarca obliqua* Stephenson) has a similar opisthodetic ligament and hinge, although the teeth extend down to the base of the hinge-plate and the ligament area is deeply inset. The trigonal outline of the shell and the smooth inner margin of *Protarca* also separate it from *Glycymerella.*

Glycymeris diaphorus Dall and *G. longior* Say, species living on the Atlantic coast of southern South America, have slightly twisted umbos and a correspondingly asymmetric cardinal area and hinge, but these features are not so pronounced as in *Glycymerella.*

Fossil and living species of *Glycymerella* seem to be confined to the West Indies and Central America. The group first appears in middle Miocene time.

Glycymeris (Glycymerella) prepennacea, new species.
(Plate 2, Figures 6, 7.)

The following is a description of this species:

Shell medium-sized, suborbicular, inflated; umbos low, strongly inflated, opisthogyrate, placed slightly in front of middle; lower anterior margin obscurely truncated; sculpture consisting of 24 almost equally spaced primary radial ribs, on young shells sharply defined and narrow, on adults most conspicuous on the umbonal slopes, becoming very low and relatively broad distally; ribs broader than interspaces and bearing a median or submedian groove on the lower two-thirds; on some shells secondary radials extend about four-fifths of distance from margin to umbo; concentric sculpture consisting of fine striae impressed on the radials, producing a cancellate effect; cardinal area narrow, deeply excavated, confined to area immediately under and behind umbo; hinge-plate gently arched; teeth in two continuous series, the posterior convex, including 15 teeth, the 5 nearest the umbo vertical and small, due to their upper part being cut off by the cardinal area, the remainder heavier and chevron-shaped; anterior series shorter and less convex, consisting of 9 relatively heavy teeth, the first 3 (from the umbo) chevron-shaped, the remainder straight and almost horizontal; muscle scars relatively large, weakly buttressed; inner margin of the valve finely fluted.

Length 26 mm.; height 25.8 mm.; diameter (left valve) 9 mm.

This species is represented by 3 left valves. The smallest shell has radial sculpture that differs somewhat from that of the largest, as the ribs are sharply defined and subangular, becoming slightly broader distally; faint secondaries appear in the lower part of some of the interspaces. On the shell of intermediate size the primary ribs are relatively broad and angular in the lower part of the shell and the secondaries are of almost the same size. On the largest shell the ribs are flat, broad, and grooved.

Glycymeris (*Glycymerella*) *prepennacea* closely resembles the living West Indian species called *G. pennacea* (Lamarck), but is

[1] L. W. Stephenson, North Carolina Geological and Economic Survey, vol. 5, part 1, pp. 103–104. 1923.

smaller, less truncate anteriorly, and has fewer ribs. The two species have the same type of sculpture. Large truncate specimens of *G. pennacea* have been collected from Miocene beds in Costa Rica and described by Olsson as *G. decussatus* (Linné).

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352738).

Genus ARCA Linné.

Subgenus ARCA s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 693.

Type (by subsequent designation, Gray, 1847).—Arca noae Linné. Recent, Mediterranean Sea.

The following is a description of the subgenus *Arca* s. s.:

Shell usually large, elongate, strongly inflated, inequilateral, posterior end keeled, middle part depressed, the depression coinciding with the wide byssal gape at the ventral margin; sculpture consisting of narrow radial ribs, differing in width and strength on different parts of the shell; cardinal area very wide, bearing chevron-shaped ligament grooves that are disconnected at the apex, and fine striations perpendicular to the hinge; hinge consisting of an anterior and posterior series of teeth, the anterior series consisting of vertical or almost vertical teeth, grading under the umbo into the smaller vertical or slightly oblique teeth at the inner end of the posterior series; away from the umbo the posterior teeth become larger and more oblique, those near the outer end chevron-shaped, those at the inner end consisting only of the upper branch of the chevron; anterior muscle-scar rounded, posterior scar larger, rectangular; inner ventral margin of valve slightly fluted.

Cossmann[1] has shown that two groups are included under *Arca* s. s. In the group of *A. noae,* the ligament occupies only part of the cardinal area; in the group of *A. umbonata* Lamarck the ligament extends to the outer edge of the cardinal area, occupying the entire area. In the group of *A. noae,* ligament grooves extend to the posterior end of the ligament area and the posteriormost grooves are not paired with anterior grooves; but in the group of *A. umbonata* the grooves usually are confined to the area under the umbo and the posterior and anterior grooves are paired.

Living species of *Arca* s. s. are most abundant in the tropical seas. Most of the Tertiary species occur in tropical faunas, but are found also in subtropical faunas.

Key to the Bowden species of Arca s. s.

Ligament grooves not confined to area under umbo..... Group of *A.* (*A.*) *occidentalis*
Posterior margin deeply emarginate..... *A.* (*A.*) *occidentalis*
Ligament grooves confined to area under umbo, posterior margin truncate ..... Group of *A.* (*A.*) *umbonata*
Posterior end of shell strongly keeled.
Sculpture relatively coarse..... *A.* (*A.*) *umbonata morantensis*
Sculpture fine ..... *A.* (*A.*) *bowdeniana*
Posterior end of shell not strongly keeled..... *A.* (*A.*) *yaquensis berryi*

[1] M. Cossmann, and A. Peyrot. Conch. Néog. de l'Aquitaine, vol. 2, part 1, p. 140. 1912.

Arca (Arca) occidentalis Philippi.

(Plate 2, Figures 8, 9.)

Arca barbadensis d'Orbigny, 1845 (?), in de la Sagra, Hist. fis., polit. y. natur. de la Isla de Cuba, Moluscos, p. 345 (Spanish ed.). 1853, in de la Sagra, Hist. phys. polit. et natur. de l'Ile de Cuba, Mollusques, vol. 2, pp. 321–322 (French ed.).

Arca occidentalis Philippi, 1847, Abbild. u. Beschreib., vol. 3, p. 29, plate 4, figs. 4*a*, 4*b*, 4*c*. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 343 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531. Dall, 1898, Trans Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 620. Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, part 1, pp. 459–460. Sheldon, 1916, Paleontographica Americana, vol. 1, p. 8, plate 1, figs. 8 to 11. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 327, plate 55, fig. 3. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, pp. 353–354, plate 25, fig. 1.

Arca noae Guppy (not Linné), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293. Dall (not Linné), 1886, Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 243.

The following is the original description of this species:

A. testa elongato-oblonga, subquadrangula; latere antico breviusulco, angulo fere recto terminato; postico emarginato; carina obtusa ab apice decurrente; costis regularibus, prominentibus, interstitia longitudinaliter striata subaequantibus; medianis parum minoribus; area dorsali mediocri; ligamento illam maxima ex part occupante. Long. 22″, alt. 10″, crass. 11″.

The following is a description of Bowden specimens of this species:

Shell large, very inequilateral, anterior end inflated, posterior end higher and compressed; anterior part of ventral margin emarginated by a long narrow byssal gape, posterior part convex; posterior margin deeply emarginate, the part dorsal to the emargination more extended; umbos situated at about anterior fourth of length, broad, inflated, slightly prosogyrate, having a slight median groove, which widens toward the ventral margin forming a wide, shallow depression, the limits of which on the ventral margin coincide with the limits of the byssal gape; posterior keel broad; radial sculpture consisting of ribs of unequal size and sculpturing in different parts of the shell (anterior to the umbonal depression the ribs are high, broad, sharply sculptured and separated by narrower interspaces; in the wide depression they are narrow, low, and the wider interspaces contain 1 to 4 fine secondary ribs that disappear on dorsal half of shell; posterior to the depression the ribs are high and broader and contain 1 or 2 furrows, the equally wide interspaces containing 2 to 5 secondary ribs; the ribs on the posterior keel are low and divided ventrally by furrows into parts of irregular width; above the posterior keel the first 3 ribs are broad and usually furrowed, but the other ribs are narrow); concentric sculpture consisting of irregular growth lines on both ribs and interspaces; cardinal area wide and long, ligament not extending to outer edge of area; ligament grooves not connected at apex, the posteriormost grooves not paired with anterior grooves; hinge long and straight; teeth numerous, becoming longer and slightly oblique at the ends; anterior and posterior inner margin strongly fluted, ventral margin along byssal gape smooth; behind the byssal gape the margin is weakly fluted.

Length 68 mm.; maximum height 28 mm.; diameter (left valve) 15 mm.

The shape is variable with regard to details, but the general proportions and sculpture are uniform. The length of the two posterior

"wings" and the depth of the emargination between them are very variable.

This species apparently is the shell that Petiver called "Mytilus Barbadensis, vulgaris, striatus, striis fuscis," cited by Sloane in his Natural History of Jamaica.[1] This name was given binomial standing by d'Orbigny in his work on the mollusks of Cuba. As there is some uncertainty concerning the date of publication of the two editions of d'Orbigny's report, it is not known whether d'Orbigny's or Philippi's name has the right of priority. The date given on the title-page of the Spanish edition is 1845, but in the text the author refers to publications that did not appear until 1846. If this edition was published in parts, like the French edition, the Arcas probably were included in the last part. Although the date of the French edition usually is given as 1853, the parts appeared at different times and the one containing the Arcas probably was published about 1847. Although d'Orbigny did not figure *A. barbadensis,* there is no doubt concerning it, as he stated that it was the shell that had been confused with the Mediterranean *A. noae.* Until more definite information is available it seems advisable to retain Philippi's name.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica. Caloosahatchee marl (Pliocene), Florida. Pleistocene, Florida Keys, West Indies. Living in the Gulf of Mexico and the West Indies, northward to Hatteras and eastward to Bermuda, in 12 to 20 fathoms.

Arca (Arca) umbonata morantensis, new subspecies.

(Plate 2, Figures 10, 11.)

The following is a description of this subspecies:

Shell small, subrhomboidal; ventral margin slightly emarginated by the short byssal gape; posterior margin obliquely truncated; umbos prominent, strongly incurved, placed at about anterior third of length of hinge; surface in front of posterior keel sculptured with radial ribs that are relatively coarse except in region of byssal gape; on the anterior half of the shell 1 or 2 fine ribs lie in the interspaces; the radial ribs are crossed by weaker low irregular concentric threads, producing an obscurely imbricate sculpture; behind the posterior keel there are 3 or 4 coarse obscurely beaded ribs, followed by several finer ribs; cardinal area wide, bearing several paired unconnected ligament grooves; inner margin of valve smooth except at posterior end.

Length 18 mm.; maximum height 8.5 mm.; diameter (left valve) 5.8 mm.

All the Bowden shells are much smaller than the living West Indian *A. umbonata umbonata,* and are more elongate and have coarser sculpture than living shells of the same size. The shells from the Tampa formation and Chipola formation of Florida, and the

[1] Voyage to the islands Madeira, Barbados, Nieves, St. Christopher, and Jamaica; with the Natural History . . . of the last of these islands, vol. 2, p. 257, No. 9. 1725.

Cercado formation of the Dominican Republic called *A. umbonata* are more similar to living shells.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352740).

Arca (Arca) bowdeniana Dall.

(Plate 3, Figures 1 to 4.)

Arca bowdeniana Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 622–623, plate 33, fig. 12. Sheldon, 1916, Paleontographica Americana, vol. 1, p. 11, plate 2, fig. 3.

The following is the original description of this species:

Shell small, inflated, somewhat irregular, very inequilateral, the beaks almost posterior; dorsal slope conspicuous; its outer border with a stout keel and its surface somewhat excavated; beaks small, pointed, prosogyrate; cardinal area wide, lozenge-shaped, flattish, with a few grooves for the resilium forming a small lozenge near the beaks; sculpture as in *A. umbonata,* the imbrications close and subnodulous; shell not alate in front and with the anterior margin nearly vertical from the hinge-line; posterior end obliquely truncate, the basal angle most extended, the dorsal one forming nearly a right angle; anterior teeth 10, posterior 27, with no noticeable hiatus in the line, the teeth resembling those of *A. paratina* but proportionately larger; interior smooth, the posterior end with a few flutings, the rest of the margin entire; the byssal foramen narrow and its margin encroaching only moderately on the valves. Lon. 15, alt. of hinge-line 6, of beaks 8, diam. (greatest posteriorly) 9 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

The umbos are anterior in position, lying at about the anterior third of the length of the hinge. The sculpture is fine. In front of the posterior keel the imbricate or cancellate effect is produced by the superposition of strong, somewhat irregular concentric threads on weaker radial ribs; above the posterior keel there are about 3 strong radial ribs, on which the concentric ridges are weak, followed by 2 or 3 narrow ribs. There is only one pair of subumbonal ligament grooves.

The largest valve has the following dimensions: length 17 mm., height 8.5 mm., diameter (right valve) 4.5 mm. The outline and proportions of shape are irregular, but certain features, including the sharpness of the posterior keel, depth of excavation of the region above the keel, and the fine obscurely imbricate sculpture are conspicuous on all shells of this species.

A. bowdeniana closely resembles *A. umbonata morantensis,* but is smaller and usually less inflated; has slightly more prosogyrate beaks, finer sculpture, larger teeth, somewhat narrower cardinal area, and stronger posterior keel. Perhaps the most striking difference lies in the diameter of different parts of the shell. The maximum diameter of *A. bowdeniana* is at about the middle, that is, behind the beaks, and rapidly decreases anteriorly across the beaks to the anterior margin; whereas *A. umbonata morantensis* has the greatest diameter

at, or just behind, the beaks and the reduction in diameter anteriorly to the margin is even more rapid.

A right valve of *A. bowdeniana* from Limon, Costa Rica (U. S. Nat. Mus. No. 135652) has a more angular keel and finer sculpture than specimens from Bowden.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 61621).

Arca (Arca) yaquensis berryi, new subspecies.

(Plate 3, Figures 5, 6.)

The following is a description of this subspecies:

Shell very small, elongate, moderately inflated, trapezoidal; ventral margin slightly contracted medially by the short, narrow byssal gape; umbos placed at about anterior third of length; posterior ridge low; sculpture consisting of many clear-cut, rounded radial ribs, very narrow in middle part of shell and widest in extreme anterior and posterior parts; the ribs may be finely and faintly beaded by numerous low concentric threads; cardinal area wide, containing a single pair of fine ligament grooves diverging from the umbo at an acute angle; hinge almost as long as shell, straight; teeth uninterrupted medially, fine, numerous; inner margin of shell deeply fluted except in median ventral part.

Length 10 mm.; height 5 mm.; diameter (right valve) 2 mm.; length of hinge 7 mm.

This small species is the most abundant *Arca* s. s. Some shells are low and elongate, others are higher, shorter, and more inflated. The radial ribs may be flat and low instead of round and high. On some shells the ribs are grooved and in the middle part of the valve secondary ribs may lie in the interspaces.

A. yaquensis berryi is much smaller than any other Bowden species of *Arca* s. s. It differs from young shells of *A. occidentalis, A. umbonata morantensis,* and *A. bowdeniana* in the absence of a sharp posterior keel, as well as in outline and sculpture. *A. yaquensis berryi* closely resembles *A. yaquensis yaquensis* Maury, described from the Cercado formation of the Dominican Republic,[1] but is more obliquely truncated posteriorly, and has wider ribs between the posterior ridge and middle of the shell and less distinct concentric sculpture. A similar small *Arca,* called *A. yaquensis* Maury by Hubbard, occurs in Porto Rico in beds ranging in age from the Lares limestone (middle or upper Oligocene) to the Quebradillas limestone (lower Miocene).

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352742).

[1] The U. S. Geological Survey party collected this species also from the Gurabo formation.

Genus BARBATIA Gray.

Subgenus BARBATIA s. s.

Section BARBATIA s. s.

Gray, 1847, Proceedings Zoological Society of London, part 15, p. 197.

Type (*by original designation*).—*Arca barbata* Linné. Recent, Mediterranean Sea.

The following is a description of the section *Barbatia* s. s.:

Shell usually large, inequilateral, moderately inflated, posterior slope rounded, byssal gape narrow; sculpture consisting of narrow radial riblets; cardinal area narrow, bearing 5 or more ligament grooves, the anterior ones shorter than the posterior, meeting under the umbo at an obtuse angle; on adult shells a narrow area in front of the umbo has no grooves, on young shells this area extends back of the umbo and occupies the entire width of the cardinal area; hinge consisting of two series of teeth, continuous on young shells, separated by an endentulous gap on adult shells; anterior series short, consisting of heavy chevron-shaped teeth, the lower branch shorter than the upper, the outermost teeth consisting of only the oblique upper branch; anterior series terminating under umbo; posterior series long, teeth under umbo short, vertical or slightly oblique, effaced on adults, outer teeth resembling those in anterior series; ventral margin of valve finely fluted.

Barbatia is here used as a genus including all Arcas having a relatively narrow cardinal area bearing chevron-shaped ligament grooves. The separation of the hinge into an anterior and posterior series is more pronounced than in *Arca* s. s.; the cardinal area is narrower; the ligament grooves meet at a more obtuse angle; and the byssal gape is narrower.

The Bowden shells here placed in the section *Barbatia* s. s. usually have been placed in *Calloarca* Gray. The type of *Calloarca, Arca alternata* Sowerby, a living species from the Pacific coast of Central America, has a shorter anterior series of teeth and an angular posterior ridge. *Calloarca* is here considered a section of the subgenus *Barbatia,* differing only in details from *Barbatia* s. s.

Living Barbatias are most abundant in the tropical seas, but range into subtropical and temperate regions. They have a long history and species are found in most of the Tertiary faunas of the world.

Key to the Bowden species of Barbatia s. s.

Byssal gape narrow.
  Length of adult shell exceeding 15 mm..... *B. (B.) islopa*
  Length of adult shell not exceeding 15 mm.
    Shell high..... *B. (B.) propertua*
    Shell elongate.
      Ribs beaded..... *B. (B.) delepida*
      Ribs not beaded..... *B. (B.) endomena*
Byssal gape wide..... *B. (B.) inusitata*

Barbatia (Barbatia) islopa, new species.

(Plate 3, Figures 7, 8.)

The following is a description of this species:

Shell medium-sized, moderately inflated, elongate, subtrapezoidal; anterior margin asymmetrically rounded; posterior margin truncated above, acutely extended below; posterior slope rounded; umbo low, lying at about anterior fourth of length; sculpture consisting of numerous, closely spaced radial ribs of different width, narrowest in central part of shell; some interspaces in central part of shell contain secondary riblets; ribs usually beaded at irregular intervals; ribs widest and strongest, interspaces widest, and beads most prominent on and behind posterior slope; cardinal area moderately narrow, containing ligament grooves that diverge from under umbo at an obtuse angle.

Length 26.5 mm.; height 13 mm.; diameter (right valve) 5.8 mm.; length of hinge 15 mm.

Most of the shells are much smaller than the holotype. This species resembles the living West Indian species that is known as "*Arca candida* Gmelin," but is much smaller, more elongate, and less inflated.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352743).

Barbatia (Barbatia) propertua, new species.

(Plate 3, Figures 9, 10.)

The following is a description of this species:

Shell small, heavy, posterior end extended below, subrounded above; umbo full, high, and broad; posterior slope rounded; ventral half of shell bearing a slight median depression; sculpture consisting of numerous fine radial ribs separated by narrow interspaces, except on the posterior slope, where the ribs are wider and the interspaces of about the same width; some of the ribs are grooved; concentric sculpture indicated by beads on the ribs; cardinal area moderately narrow, bearing transvere striations; inner margin of valve not definitely fluted.

Length 8 mm.; height 5.8 mm.; diameter (right valve) 1.8 mm.; length of hinge 4.5 mm.

The small right valve on which the description is based probably is not full grown, as there are no recognizable ligament grooves. The cardinal area is wider and the posterior slope more rounded than in the section *Acar*.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352744).

Barbatia (Barbatia) delepida, new species.

(Plate 3, Figures 11, 12.)

The following is a description of this species:

Shell small, base almost straight, its middle part slightly emarginate; posterior margin extended below, obliquely truncated above; umbo broad;

posterior slope rounded; sculpture consisting of numerous fine radial ribs, ornamented with conspicuous, delicately sculptured, square or slightly elongate beads; as usual, the ribs and interspaces are wider at the anterior and posterior ends, especially on the posterior slope; cardinal area wide for size of shell, containing obscure transverse striations in anterior and middle parts and deeper oblique ligament grooves at posterior end; anterior and posterior inner margins obscurely fluted.

Length 6.5 mm.; height 4.2 mm.; diameter (left valve) 1.8 mm.; length of hinge 5 mm.

The delicate reticulate sculpture is the prominent feature of this species, which also is represented only by a small probably immature valve. It resembles *B. propertua* but is more rectangular and has more delicate and more uniform sculpture, and wider cardinal area.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352745).

Barbatia (Barbatia) endomena, new species.

(Plate 3, Figures 13, 14.)

The following is a description of this species:

Shell small, elongate, subtrapezoidal, inflated; dorsal and ventral margins subparallel; posterior end truncated; umbo full, broad, lying at about anterior third of length; posterior slope round; sculpture consisting of numerous radial ribs; extreme anterior ribs separated by interspaces of virtually the same width, following ribs narrower, the interspaces wider than the ribs and containing a fine secondary rib; towards the posterior slope the ribs are wider and separated by narrow grooves; on the posterior slope the ribs are few and broad and the interspaces are of about the same width; ribs bearing obscure elevations along concentric lines, except on anterior part of shell, where the concentric sculpture forms definite beads; cardinal area moderately wide, posterior part containing oblique ligament grooves; posterior and anterior inner margins obscurely fluted.

Length 10 mm.; height 5.5 mm.; diameter (right valve) 2.5 mm.; length of hinge 6.5 mm.

B. endomena is known from a small valve that may not be full grown. The outline of the shell suggests the section *Acar,* but the cardinal area is wider than in *Acar* and the posterior slope more rounded. It is more elongate and more inflated than young shells of *B. islopa* of the same size, and has higher umbos and less conspicuous concentric sculpture.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352746).

Barbatia (Barbatia) inusitata, new species.

(Plate 3, Figures 15, 16.)

The following is a description of this species:

Shell medium-sized, high, somewhat compressed, outline irregular; posterior margin obliquely truncated above, extended below; anterior part of the ventral margin distorted by the long, wide byssal gape; umbos relatively low, broad, lying at about anterior third of length; posterior ridge promi-

nent, region behind ridge excavated; radial sculpture consisting of numerous narrow, irregular ribs; some of the ribs are grooved and a few interspaces bear narrower secondary ribs; interspaces usually narrower than ribs; posterior slope sculptured with 4 ribs much coarser than the others; concentric sculpture consisting of irregular growth-lines and occasional threads, producing in certain parts of shell obscure reticulate sculpture; cardinal area relatively short and wide, conspicuously marked by 6 or 7 concentric ligament grooves that diverge at a wide angle; hinge gently arched; anterior teeth chevron-shaped, median teeth very short, posterior teeth large, oblique; inner margin of shell faintly fluted.

Length 31.5 mm.; height 22 mm.; diameter (right valve) 7.8 mm.; length of hinge 12 mm.

B. inusitata has a wider byssal gape and wider cardinal area than the type species of *Barbatia.* Its irregular distorted shape, prominent byssal gape and excavated posterior slope are characteristic features. Several similar species have been described, such as *B. irregularis* Dall, from the Tampa formation of Florida, and *B. marylandica* (Conrad), from the upper Miocene formations of Maryland and the lower Miocene Chipola marl of Florida.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352747).

Section ACAR Gray.

Gray, 1887, Annals and Magazine of Natural History, ser. 2, vol. 19, p. 369.

Type.—Arca gradata Broderip and Sowerby. Recent, Pacific coast of Mexico and Central America.

The following is a description of the section *Acar*:

Shell medium-sized, trapezoidal, posterior end keeled; byssal gape narrow; sculpture coarsely reticulate and imbricate; cardinal area narrow behind umbo, wider in front of umbo, ligament confined to narrow area behind umbo; ligament grooves slightly bent behind umbo; teeth resembling those of *Barbatia* s. s., but the anterior series are longer; ventral margin fluted, except at byssal gape.

Gray included the following 3 species under *Acar* without designating a type; *B.* (*arbatia*) *reticulata, B. divaricata,* and *B. gradata.* The name *Arca reticulata* was first given binomial standing by Gmelin,[1] who referred to figures given by Lister, Martini, and Chemnitz. The name has commonly been accepted for the shell that Chemnitz[2] figured. Chemnitz gave the West Indies as the probable locality, but Kobelt[3] states that the shell figured by Chemnitz came from the Indian Ocean. The figure does not resemble the West Indian *Arca* that goes under the name of *reticulata.* Sowerby[4] de-

[1] Gmelin. Syst. Nat., ed. 12, vol. 6, p. 3311. 1792.
[2] J. H. Chemnitz. Neus Syst. Conch.-Cab., vol. 7, pp. 193–194, plate 54, fig. 540. 1784.
[3] W. Kobelt. Syst. Conch.-Cab. von Martini und Chemnitz: Band 8, Abtheilung 2, Die Gattung *Arca* L., p. 211. 1891.
[4] G. B. Sowerby. Proc. Zool. Soc. London, pt. 1, p. 18. 1833.

scribed *Byssoarca divaricata* from "Annaa or Chain Island" in the East Indies. *Arca gradata* was described by Broderip and Sowerby[1] from Mazatlan on the Pacific coast of Mexico.

Several writers have cited *A. donaciformis* Reeve as the type of *Acar,* because Fischer[2] gave it as an example of *Acar.* Apparently no type from the original list has been designated. *A. gradata* Broderip and Sowerby is herewith designated the type, as it is the best known of the three species. Some writers consider *A. gradata* identical with the West Indian species known as *A. reticulata.*

The hinge and cardinal area of *Acar* resemble those of young specimens of *Barbatia barbata* of the same size, but the ligament area is narrower. The imbricate sculpture is a striking feature.

There are only a few Tertiary and living species of *Acar.* Both the living and fossil species are found only in tropical or subtropical faunas.

Barbatia (Acar) domingensis (Lamarck).

(Plate 3, Figures 17, 18.)

Arca domingensis Lamarck, 1819, Hist. Nat. des Anim. sans. Vert., vol. 6, p. 40.

Arca squamosa Guppy (not Lamarck), 1874, Geol. Mag., decade 2, vol. 1, p. 443 (list).

Arca reticulata Dall (not Chemnitz), 1886, Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 242. Dall (not Gmelin, 1889, U. S. Nat. Mus. Bull. 37, p. 42. Dall and Simpson (not Gmelni), 1901, U. S. Fish Comm. Bull., vol. 20, part 1, p. 460. Sheldon (not Gmelin), 1916, Paleontographica Americana, vol. 1, p. 20, pl. 4, figs. 8–12.

Barbatia (*Acar*) *reticulata* Dall (not Gmelin), 1898, Trans. Wagner Free Inst. Sci., Philadelphia, vol. 3, part 4, p. 629. Dall (not Gmelin), 1915, U. S. Nat. Mus. Bull. 90, p. 120. Maury (not Gmelin), 1917, Bull. Amer. Pal., vol. 5, p. 330, plate 30, fig. 16. Maury (not Gmelin), 1920, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 1, pp. 7–8, N. Y. Acad. Sci. Hubbard (not Gmelin), 1921, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 2, p. 106, N. Y. Acad. Sci.

The following is the original description of this species:

A. testa transversim oblonga, decussatim striata; antico latere producto, subacuto, granoso; natibus approximatis.

Habite l'Oceán des Antilles, à S-Domingue.

The following is a description of Bowden specimens of this species:

Shell small, thick, subrhomboidal, moderately inflated; posterior end obliquely truncated; umbos low, broad, strongly incurved, placed at about anterior third of length; posterior keel subangular; sculpture consisting of strong, somewhat irregular concentric ridges, separated by deeply channeled narrow grooves, and less prominent, but more numerous, radial ribs; the concentric ridges often give an imbricate effect, especially on the posterior ridge, and some ridges bear fine concentric striae; posterior slope less strongly sculptured; cardinal area narrow, excavated, wider in front

[1] W. J. Broderip and G. B. Sowerby. Zool. Jour., vol. 4, pp. 365–366. 1829.

[2] P. Fischer. Man. Conch., p. 975. 1887.

of umbo, part behind umbo bearing slightly oblique grooves; muscle scars prominent, the edges raised above surface of shell; inner margin of the valves finely and irregularly fluted.

Length 19 mm.; height 11 mm.; diameter (left valve) 5 mm.; length of hinge 10 mm.

According to the evidence discussed on page 36, it seems that Gmelin's name is not available for this common West Indian species, and consequently Lamarck's name is adopted.

This species, which has an extended geological range in the West Indies and regions nearby, is represented by many specimens in the collections from Bowden, but none is so large as some of the living ones. The shape and peculiar half-imbricate and reticulate sculpture alone distinguish it from the other Bowden Arcas.

Other localities.—Tampa formation (lower Miocene), Florida. Ponce chalky beds (lower Miocene), Porto Rico. Chipola formation (lower Miocene), Florida. Cercado formation (lower Miocene), Dominican Republic. Quebradillas limestone (lower Miocene), Porto Rico. Miocene (?), Matura, Trinidad. Caloosahatchee marl (Pliocene), Florida. Pleistocene, West Indies. Living in West Indies, northward to Hatteras and eastward to Bermuda, in shallow water.

Subgenus OBLIQUARCA Sacco.

Sacco, 1898, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, part 26, p. 16.

Type (*by original designation*).—*Arca modioliformis* Deshayes. Eocene, Paris Basin.

The following is a description of the subgenus *Obliquarca*:

Shell small, subovate, moderately inflated, very inequilateral; umbos almost terminal, prosogyrate; sculpture consisting of fine, slightly beaded radial ribs; cardinal area very narrow, part behind umbo marked by wide deep ligament grooves separated by narrow sharp-edged ridges, part in front of umbo more elevated and longitudionally striate; hinge consisting of two series of teeth, anterior series comprising a few heavy oblique teeth, posterior series comprising a large number of teeth that are small and vertical at anterior end of series, and larger and oblique at posterior end; on some shells the two series are separated by an edentulous gap due to the lowering of the ligament; posterior muscle-scar slightly larger than the anterior; ventral margin of valve smooth.

The division of the hinge into an anterior and posterior series is more pronounced than in the subgenus *Barbatia* s. s., but the cardinal area is essentially the same as in young specimens of *Barbatia barbata.*

All the Bowden species of *Obliquarca* have a smaller and heavier series of anterior teeth than the type species. Only 1 Bowden species, *A. modiolida,* is modioloid like the type species, and has an even narrower cardinal area than the type species. The other 2 species, especially *O. subcandida,* resemble *Barbatia* externally, but they are Obliquarcas in the features of the hinge and cardinal area.

Obliquarcas heretofore were known only from Eocene beds of the Paris Basin and southern Europe and late Tertiary deposits of the Mediterranean region. Some of the living tropical Barbatias may be Obliquarcas, as Cossmann has suggested.

Key to the Bowden species of Obliquarca.

Outline not modioloid.
  Shell strongly inflated..... *B. (O.) dentera*
  Shell weakly inflated..... *B. (O.) subcandida*
Outline modioloid..... *B. (O.) modiolida*

Barbatia (Obliquarca) dentera, new species.

(Plate 3, Figures 19, 20.)

The following is a description of this species:

Shell small, strongly inflated, very inequilateral; posterior end extended and abruptly rounded, base gently arcuate; umbos full, broad, placed almost at anterior fifth of length; posterior ridge broad and low; radial sculpture consisting of numerous narrow, weakly sculptured ribs of varying width, widest at posterior end; concentric sculpture consisting of irregularly spaced incrementals, slightly beading the radial ribs; cardinal area narrow, part behind umbo depressed and crossed by wide, deep ligament grooves; part under umbo elevated and horizontally striate; anterior series of teeth consisting of 6 thickened irregular teeth placed under umbo, the thickened area ceasing abruptly behind the umbo, followed by the posterior series, consisting of 23 teeth which increase in size toward outer end and at the end become oblique.

Length 16 mm.; height 10.5 mm.; diameter (left valve) 4.1 mm.; length of hinge 9 mm.

The holotype is the only specimen of this species. The shape and sculpture suggest *Barbatia* s. s.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352749).

Barbatia (Obliquarca) subcandida, new species.

(Plate 3, Figures 21, 22.)

The following is a description of this species:

Shell small, subovate, slightly inflated; posterior end higher; anterior end subtruncated; ventral margin sloping gently downward toward posterior end; umbo low and flat, lying at about anterior fifth of length; posterior ridge low and broad in umbonal region, disappearing toward lower margin; radial sculpture consisting of numerous fine ribs, narrowest in the part below the umbo and widest at posterior end; ribs separated by fine grooves, except on posterior slope, where between some ribs are interspaces as wide as the ribs; concentric sculpture consisting of regular, closely spaced concentric threads, overriding the radials, producing a reticulate sculpture and beading the ribs on the posterior slope; cardinal area narrow, part behind umbo depressed, having wide ligament-grooves; part under and in front of umbo wider, elevated, and horizontally striate; hinge as in *O. dentera*, but 5 teeth are in anterior series and 18 in posterior.

Length 13 mm.; umbonal height 7.6 mm.; maximum height 8.2 mm.; diameter (right valve) 2.8 mm.; length of hinge 7 mm.

This species, also known only from the holotype, closely resembles *B. dentera,* but is more compressed, and has stronger sculpture.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352750).

Barbatia (Obliquarca) modiolida, new species.

(Plate 3, Figures 23, 24.)

The following is a description of this species:

Shell small, thin, modioliform, somewhat compressed, very inequilateral, posterior end higher; umbos low, almost terminal; posterior ridge not well defined near lower margin, high and broad in umbonal region; radial sculpture consisting of low, fine ribs, separated by grooves in the part in front of the posterior ridge; radials behind posterior ridge coarser, swollen, and separated by wider interspaces; concentric sculpture consisting of threads and irregular incrementals, producing a reticulate sculpture on unworn parts of shell; cardinal area very narrow, part behind umbo deeply depressed, almost internal, bearing 2 wide ligament-grooves; the part under umbo elevated; anterior teeth 4 to 6, slightly oblique, more or less irregular, subumbonal in position, medial teeth very short and weak, or absent, producing a long edentulous gap; about 8 oblique teeth at outer end of posterior series; ventral margin of valve smooth or finely fluted.

Length 10 mm.; umbonal height 4.1 mm.; maximum height 6 mm.; diameter (left valve) 1.9 mm.

The peculiar outline of this small species at once distinguishes it from the other Bowden Arcas. It is represented by a number of valves, several of which are slightly larger than the holotype. The cardinal area is very narrow and the part behind the umbo is so deeply depressed that it is almost internal. The hinge is typical of the subgenus, as it is divided into two series, but the teeth in the middle of the hinge are very weak or absent, leaving only the irregular anterior teeth and the oblique regular teeth at the outer end of the posterior series.

All the valves are more or less worn, so that their sculpture is faint. Several shells are less inflated and more compressed in the posterior dorsal part than the holotype.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352751).

Subgenus DILUVARCA, new name.

Section DILUVARCA s. s.

Anadara of authors, not of Gray, 1847.
Scapharca of authors, not of Gray, 1847.

Type.—Arca diluvii Lamarck. Miocene to Recent, Mediterranean Sea.

The following is a description of the section *Diluvarca* s. s.

Shell heavy, medium-sized, moderately elongate, strongly inflated, inequilateral, equivalve, valves closed along ventral margin; umbos high and full; sculpture consisting of strong, narrow, flattened radial ribs separated by squarely channeled interspaces, ribs beaded by concentric threads;

cardinal area relatively wide, on adult shells almost entire area occupied by ligament and bearing chevron-shaped ligament grooves diverging from under umbo at an obtuse angle; hinge uninterrupted, but consisting of two series of teeth unequal in length; the shorter anterior series comprising teeth that are slightly oblique at anterior end and become vertical but not much reduced in size at posterior end; the longer posterior series comprising teeth that are strongly oblique at posterior end and become vertical and very small at anterior end; posterior muscle-scar quadrangular, larger than the rounded anterior scar; margin of valve deeply fluted.

This group of Arcas is called *Anadara* by European paleontologists. Gray[1] designated "*A. antiquata, Arca,* sp. Linn." as the type of *Anadara.* Therefore the type is *Arca antiquata* Linné, 1758, and not *Arca antiquata* Poli 1795 (=*Arca diluvii* Lamarck), which usually is given as the type. The exterior of the type of *Arca antiquata* Linné has been figured by Hanley,[2] who states that its locality is not known. Figures 1 and 2 on plate 4 are photographs of Linné's type kindly sent by the General Secretary of the Linnean Society of London and published with his consent. The number 144 visible on figure 1 corresponds to the number for *Arca antiquata* on page 694 of the tenth edition of the Systema Naturae. These photographs and Hanley's figure show that *Arca antiquata* externally resembles some of the American species of *Argina,* but has a byssal gape. Its cardinal area is moderately wide, but no ligament grooves are visible. The hinge is heavy; the anterior series of teeth is relatively long and not clearly separated from the posterior series. There are no similar Tertiary or living American Arcas.

The same group of Arcas is called *Scapharca* by American paleontologists. The type of *Scapharca* Gray,[3] *Arca inaequivalvis* Brugière, is thin-shelled, subquadrate, subequilateral, and inequivalve, the left valve being larger than the right. The cardinal area is very narrow, except in front of the umbo, where the ligament extends as a narrow wedge half or less of the distance from the umbo to the anterior margin; the remainder of the cardinal area in front of the umbo is elevated and striate. The sculpture is similar to that of *Diluvarca.*

Diluvarca has essentially the same kind of cardinal area and hinge as *Barbatia* s. s., but its cardinal area is wider; the anterior series of teeth is relatively longer and is not so distinctly separated from the posterior series. On young shells or on small adult shells the ligament is confined to the part of the cardinal area behind the umbo and contains one or two oblique ligament-grooves, like in young valves of *Barbatia barbata.* On such shells the part of the cardinal area in front of the umbo is more elevated and has vertical and horizontal striations.

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[1] J. E. Gray. Proc. Zool. Soc. London, part 15, p. 198. 1847.
[2] S. Hanley. Ispa Linnaei Conchylia, pp. 93–95, plate 4, fig. 3. 1855.
[3] J. E. Gray. Proc. Zool. Soc. London, part 15, p. 198. 1847. *Type* (*by original designation*), *Arca inaequivalvis* Bruguière.

There are more living and Tertiary species of *Diluvarca* than of any other kind of *Arca*. Their Tertiary and present distribution is virtually cosmopolitan.

Key to the Bowden species of Diluvarca s. s.

1. Outline not subglobose.
   - A. Length of adult shell exceeding 45 mm., ribs numbering 35 ..... *B. (D) halidonata*
     - B. Shell high ..... *B. (D.) halidonata halidonata*
     - BB. Shell elongate ..... *B. (D.) halidonata oresta*
   - AA. Length of adult shell not exceeding 45 mm., but exceeding 10 mm.
     - C. Shell high.
       - D. Shell not obliquely truncate posteriorly, ribs numbering 33 ... *B. (D.) perplura*
       - DD. Shell obliquely truncate posteriorly, ribs numbering 32 ..... *B. (D.) prephina*
     - CC. Shell elongate.
       - E. Shell obliquely extended posteriorly, ribs numbering 30 ..... *B. (D.) inaequilateralis*
       - EE. Shell not obliquely extended posteriorly.
         - F. Ribs distant.
           - G. Interspaces wider than ribs, ribs numbering 26.. *B. (D.) dasia*
           - GG. Interspaces narrower than ribs, ribs numbering 32 ..... *B.(D.) wordeni*
         - FF. Ribs crowded.
           - H. Shell obliquely truncate posteriorly, ribs numbering 40.. *B. (D.) agnastha*
           - HH. Shell not obliquely truncate posteriorly, ribs numbering 36.... *B. (D.) thomasensis*
   - AAA. Length of adult shell not exceeding 10 mm., ribs numbering 24 ..... *B.(D.) donacia*
2. Outline subglobose.
   - I. Outline not cardioid, shell moderately inflated ..... *B. (D.) microtera*
   - II. Outline cardioid, shell strongly inflated ..... *B. (D.) ophthanta*

Barbatia (Diluvarca) halidonata halidonata (Dall).

(Plate 4, Figures 3, 4.)

Arca consobrina Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293. Guppy (part, not Sowerby), 1874, Geol. Mag., decade 2, vol. 1, p. 443 (list).

Scapharca (*Scapharca*) *halidonta* Dall, 1898, Trans. Wagner Free Inst. Sci., Philadelphia, vol. 3, part 4, pp. 646–647, plate 33, fig. 24. Sheldon, 1916, Paleontographica Americana, vol. 1, p. 49, plate 11, fig. 8.

The following is the original description of this subspecies:

Shell subequivalve, ovate, oblique, inflated; beaks rather high, strongly bent forward, almost reaching the anterior fourth of the length; left valve larger, with about 34 clear-cut, elegantly sculptured radial ribs; the anterior

dozen ribs are usually dichotomous or deeply sulcate; the ribs on the middle of the shell are grooved with 1 or 2 shallow, sharp, incised lines; the more posterior ribs are wider and flatter with 3 or more grooves; those on the posterior dorsal slope are angular, narrower, and usually have not more than 1 groove, which is nearly obsolete; the concentric sculpture is of evenly spaced, fine elevated lines arched in the interspaces and finely nodulating the anterior ribs; the sculpture is similar on both valves; the anterior end of the shell is rounded, the base arcuate, the posterior end oblique above and produced below; the ends of the hinge-line are angulate; the cardinal area is moderately wide with about 3 concentric lozenges outlined by the grooving; the hinge-line is straight, the teeth numerous and mostly vertical, the two series not interrupted, the posterior distal teeth tending to become irregular in the adult. Long. of shell 55, of hinge-line 41, alt. 40, diam. 40 mm.; large specimens reach a length of 68 mm.

Type locality.—Bowden, Jamaica.

This subspecies is the most abundant *Arca* and all stages of growth are represented. Young shells have a different shape, as the upper part of the posterior lateral margin is not obliquely truncated and its lower part is less extended. Young and adult shells differ also in details of sculpture. On medium-sized shells only a few of the anterior ribs are grooved and the threads on the posterior ribs are absent; on young shells the ribs in even the extreme anterior part of the shell are not grooved; thus there is a progressive decrease in the number of anterior ribs that are grooved. Some immature shells, left valves in particular, are more inflated than others and have more deeply channeled interspaces.

Guppy identified this species as *Arca consobrina* Sowerby (not *A. consobrina* d'Orbigny), described from the Dominican Republic. The difference between the Bowden and Dominican species is described under the following subspecies.

Other localities.—Miocene, Curaçao.[1]

Type material.—14 cotypes (U. S. Nat. Mus. No. 135756).

Barbatia (Diluvarca) halidonata oresta, new subspecies.

(Plate 4, Figures 5, 6.)

The following is a description of this subspecies:

Shell large, subtrapezoidal, elongate, length more than one and one-half times height, strongly inflated; umbo low and flat, lying at almost anterior third of shell; anterior lateral margin rounded; posterior lateral margin obliquely truncated above and extended below; posterior half of ventral margin subparallel to dorsal margin, anterior half arcuate; sculpture as in *B. halidonata halidonata.*

Length 70 mm.; height 44 mm.; diameter (right valve) 21 mm.; length of hinge 52 mm.

B. halidonata halidonata is relatively high and has high prominent umbos, but some of the shells are more elongate and have lower umbos. Three very elongate shells are separated as the subspecies *oresta.*

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[1] See footnote on page 25.

B. halidonata oresta closely resembles *B. henekeni* (Maury), described from the Dominican Republic, but is larger and has less deeply grooved ribs. The Bowden subspecies also resembles *B. lienosa* (Say), from the upper Miocene (Duplin marl) and Pliocene (Waccamaw and Caloosahatchee marls), but is smaller, less evenly rounded anteriorly, and has fewer and higher ribs. The living West Indian species, *B. secticostata* (Reeve) is more evenly rounded anteriorly and has wider interspaces.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352752).

Barbatia (Diluvarca) perplura, new species.

(Plate 4, Figure 7.)

The following is a description of this species:

Shell medium-sized, heavy, greatly inflated, moderately inequilateral; base gently and evenly rounded; anterior and posterior ends rounded; umbos moderately high, bearing an inconspicuous median groove, lying at about anterior third of length; radial sculpture consisting of 33 flat-topped ribs of uniform width, separated by narrower deeply channeled interspaces; on the posterior slope the ribs are lower and the interspaces wider than in other parts of shell; concentric sculpture consisting of fine, usually evenly spaced threads, producing low beads on the ribs, except on posterior slope; cardinal area moderately wide, bearing 2 ligament-grooves behind umbo; margin of valve deeply fluted.

Length 23.5 mm.; height 17.5 mm.; diameter (left valve) 9.6 mm.; length of hinge 17 mm.

B. perplura is represented by 2 left valves. It closely resembles small shells of *B. halidonata,* but is more elongate, heavier, less compressed in the posterior dorsal part, more inflated, and has fuller, more prominent umbos, higher ribs, and more deeply channeled interspaces. It is smaller than *B. actinophora* (Dall), from the Gatun formation of the Canal Zone, and has fewer and wider ribs.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352753).

Barbatia (Diluvarca) prephina, new species.

(Plate 4, Figure 8.)

Arca (*Scapharca*) *auriculata* Lamarck ?, Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 649.

The following is a description of this species:

Shell medium-sized, greatly inflated; posterior end truncated; anterior end rounding by a broad curve into the gently and asymmetrically arcuate base; umbos moderately high, lying at about anterior third of length; posterior ridge strong, rounded, posterior slope excavated; left valve slightly larger, sculptured with 32 square ribs separated by interspaces wider than the ribs in anterior and middle parts of shell, but narrower in posterior part; on anterior half of shell lower parts of ribs grooved, on the posterior slope they are flatter and broader; all ribs except those on the posterior slope beaded by numerous concentric threads extending across interspaces; right

valve sculptured with 30 lower and broader ribs, interspaces of about the same width in anterior half of shell and narrower in posterior half; only the anterior 6 or 7 ribs grooved; beads limited to the anterior ribs and not so sharp as on left valve; cardinal area moderately wide, bearing 3 to 5 ligament grooves behind umbo.

A right valve (holotype): length 35 mm.; height 24 mm.; diameter 10 mm.; length of hinge 22 mm. A left valve: length 38 mm.; height 25 mm.; diameter 12.5 mm.; length of hinge 24 mm.

B. prephina closely resembles the living West Indian *B. auriculata* (Lamarck). The Bowden species is smaller, has more numerous, lower, and more conspicuously headed ribs, and much narrower interspaces. Maury records *B. auriculata* from Miocene beds in the Dominican Republic, and Olsson from Miocene beds in Costa Rica.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352754).

Barbatia (Diluvarca) inaequilateralis (Guppy).

(Plate 5, Figures 1 to 3.)

Arca inaequilateralis Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, pp. 293–294, plate 28, fig. 2. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 443 (list). Sheldon, 1916, Paleontographica Americana, vol. 1, p. 50, plate 11, figs. 11, 12. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 403.

Scapharca (*Scapharca*) *inaequilateralis* (Guppy), Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 647.

Scapharca inaequilateralis (Guppy) Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 335, plate 56, fig. 8.

The following is the original description of this species:

Shell transverse, slightly oblique, very inequilateral, produced posteriorly; valves with about 30 crenate radiating ribs, single on the disk, where they are not broader than one-third of their interstices; double anteriorly and posteriorly, where they are equal in width to the interstices; hinge-line long, straight, forming an abrupt angle with the rounded anterior margin; posterior margin with an oblique slope.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell small, thin, elongate, subovate, moderately inflated; umbos low, lying at about anterior third of length; upper part of posterior margin obliquely truncated, lower part extended; ventral margin sloping toward posterior end; sculpture of the two valves similar, consisting of about 30 radial ribs, the one adjacent to the anterior dorsal margin usually small and narrow; the next 8 to 12 broad, wider than the interspaces which bear a shallow, broad, median groove; ribs in central part of shell narrow, usually less than half as wide as interspaces, and usually square; posterior ribs, 9 to 11 in number, much wider than interspaces, flat, and bearing a narrow groove (rarely 2), which almost or entirely disappears on the ribs in extreme posterior dorsal part; concentric sculpture consisting of fine, closely set threads, producing on the grooved anterior ribs a double row of beads and a single row on the undivided medial ribs, the beads of the median ribs

usually more conspicuous on the left valve; posterior ribs not affected by the concentric sculpture; cardinal area narrow, bearing 1 to 3 ligament grooves behind the umbo; ventral margin of valve deeply fluted and from the flutings faint rays, most noticeable in the posterior part, run up toward the umbo.

Length 31 mm.; height 16.7 mm.; diameter (right valve) 7 mm.; length of hinge 19 mm.

The small thin shells of this species are numerous. A few shells have a faint shallow groove on the umbo.

B. inaequilateralis closely resembles, as Dall has pointed out, *B. latidentata* (Dall) described from the Chipola formation, but its posterior end is more extended, and it has a thinner shell, narrower ribs, and finer, shorter, and more numerous teeth. Maury has recorded *B. inaequilateralis* from the Cercado formation of the Dominican Republic.

Other localities.—Cercado formation (lower Miocene), Dominican Republic.

Type material.—2 cotypes (British Museum (Natural History), Geological Department, No. 64089).

Barbatia (Diluvarca) dasia, new species.

(Plate 5, Figure 4.)

The following is a description of this species:

Shell medium-sized, heavy, subrhomboidal, elongate, much inflated, posterior end slightly higher and obliquely truncate; umbo high, inflated, the tip slightly depressed medially; left valve sculptured with 26 high, square ribs, separated by wider deeply channeled interspaces; on the posterior slope the ribs are lower and flatter; anterior ribs about as wide as interspaces; concentric sculpture consisting of threads, producing faint beads on tops of ribs and inconspicuous threads on sides of ribs and in interspaces; cardinal area moderately wide, wider in front of umbo, bearing 5 ligament grooves behind umbo; ventral margin of valve bearing broad, deep flutings.

Length 31.5 mm.; height 19 mm.; diameter (left valve) 10 mm.; length of hinge 23 mm.

This species, which is represented only by the holotype, a left valve, closely resembles *B. honensis* (Olsson),[1] a Miocene species from Costa Rica, but is lower and its anterior end is more extended.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352755).

Barbatia (Diluvarca) wordeni, new species.

(Plate 5, Figure 5.)

The following is a description of this species:

Shell medium-sized, moderately inflated, heavy, elongate; umbo inflated, low, bearing a faint median groove; left valve sculptured with 32 square ribs of almost uniform width except at ends, flattened on the posterior slope; interspaces narrower than ribs; except on the posterior slope the ribs

[1] Comparison based on figures.

and interspaces are crossed by concentric threads beading the ribs; right valve sculptured with 30 or 31 lower and usually narrower ribs, separated by interspaces of about the same width; concentric threads prominent in interspaces, but beading only a few anterior ribs; cardinal area narrow, bearing 1 or 2 ligament grooves behind umbo; ventral margin deeply fluted.

Length 25.5 mm.; height 17 mm.; diameter (left valve) 8.2 mm.; length of hinge 18 mm.

B. wordeni is characterized by its rather elongate and inflated outline, thick shell, and relatively high undivided ribs separated by deeply channeled interspaces. Young shells are proportionately less inflated than adults and their umbonal groove is more prominent. *B. inaequilateralis* is of about the same size, but is much thinner, more extended at the posterior end, less inflated, and has finer ribs; *B. perplura* is higher, heavier, and has fuller, more prominent beaks, wider ribs, and narrower interspaces. *B. hypomela* (Dall), described from the Chipola formation, has the same outline, but is much larger and has lower, deeply grooved ribs and wider cardinal area.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352756).

Barbatia (Diluvarca) agnastha, new species.

(Plate 5, Figure 6.)

The following is a description of this species:

Shell small, thin, moderately inflated, posterior end higher, posterior dorsal part compressed, posterior margin truncated; umbo low, relatively broad, placed at about anterior third of length, bearing an obscure median groove; sculpture consisting of 40 low, narrow, flat radial ribs, broader and flatter on the posterior slope, separated by narrower interspaces; in the interspaces are faint concentric threads that extend across the ribs, except those on the posterior slope, producing obscure beads; cardinal area moderately wide, bearing a ligament-groove behind umbo; ventral margin fluted.

Length 21.8 mm.; height 12.8 mm.; diameter (right valve) 5 mm.; length of hinge 16 mm.

The posterior dorsal compression produces an auriculate outline, particularly on small shells. The ventral margin rapidly ascends toward the anterior end. These features, the numerous narrow, flattened ribs and small size of the shell separate this species from the other Diluvarcas. Small shells, besides being more auriculate, have a relatively higher posterior end and more prominent umbonal groove. It is difficult to separate young shells of *B. agnastha* and of *B. wordeni;* those of *B. agnastha* usually are more elongate, more auriculate and have more numerous and finer ribs. The adults are easily separated, as the shell of *B. wordeni* is heavier, larger, higher, more inflated, and its ribs are coarser and higher. *B. agnastha* is smaller, thinner, more elongate, and less inflated than *B. prephaina* and has more numerous and finer ribs. *B. acompsa* (Dall), described from the Chipola formation, has a more extended anterior margin, a straighter base, wider and divided ribs.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352757).

Barbatia (Diluvarca) thomasensis, new species.

(Plate 5, Figure 7.)

The following is a description of this species:

Shell small, inflated, moderately inequilateral, posterior end slightly extended; umbo moderately high, lying in front of middle, the tip slightly grooved medially; sculpture consisting of 36 narrow, square-topped closely set radial ribs, separated by narrower interspaces; the anterior 7 or 8 ribs and the accompanying interspaces relatively wide; the next 8 narrow and the following ones progressively slightly broader, those on the posterior slope broadest and flattest; concentric sculpture consisting of irregular inconspicuous threads that faintly and unevenly bead the anterior and median ribs; cardinal area moderately wide, bearing a single ligament groove behind the umbo; ventral margin of shell deeply fluted; interior of shell marked with fine inconspicuous radial rays.

Length 19.5 mm.; height 12 mm.; diameter (left valve) 5.1 mm.; length of hinge 14 mm.

This species is represented by a left valve. It may be a young shell similar to *B. actinophora* (Dall), from the Gatun formation of the Canal Zone, but no larger shells have been found. In outline and in the number and size of the ribs it resembles the much larger Gatun species. It also is very similar to *B. willobiana* (Cooke), a middle Oligocene species of the same size from Antigua, but is more inflated and has a few more ribs.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352758).

Barbatia (Diluvarca) donacia (Dall).

(Plate 5, Figures 8 to 11.)

Scapharca (*Scapharca*) *donacia* Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 649, plate 33, fig. 13. Sheldon, 1916, Paleontographica Americana, vol. 1, p. 50, plate 11, fig. 14.

The following is the original description of this species:

Shell small, donaciform, moderately plump, with rather elevated prosocoelous beaks at about the anterior third; valves almost similarly sculptured; left valve with about 24 low, strap-like, narrow radial ribs with somewhat wider interspaces; the ribs are plain, smooth, and entire on both valves; on the left valve the interspaces are crossed by numerous equidistant elevated lines which do not appear on the ribs; on the right valve the interspaces are only marked by lines of growth; hinge-line short, cardinal area very narrow, smooth; anterior end larger, rounded; posterior end produced and attenuated; hinge teeth small, similar, slightly divergent; internal margin of the valves with deep short flutings. Lon. 6.8, alt. 4.5, diam. 3 mm.

Type locality—Bowden, Jamaica.

The following supplements the original description of this species:

The umbos are relatively high and conspicuous. The umbo of most right valves bears a shallow narrow groove. Toward the ventral margin this

groove broadens and slightly emarginates the base. On the left valve the groove is absent or obscure. The ribs (4 to 6) in the groove, and in a corresponding position on left valves, are narrower and flatter than the others. On unworn valves fine, evenly and closely spaced concentric threads, usually more prominent on left valves, are visible in the interspaces. The cardinal area is narrow and bears a single ligament groove behind the umbo. The deep, short flutings of the ventral margin are absent where the median groove reaches the base.

Length 9 mm.; height 6 mm.; diameter (right valve) 2.5 mm.; length of hinge 5 mm.

B. donacia is a small species, but is represented by a large number of shells of various stages of growth. *B. cibaoica* (Maury), a very similar species described from the Cercado formation of the Dominican Republic and also known in the Gurabo formation, is less elongate and has a more conspicuous median groove. A similar small *Diluvarca, B. guajataca* (Maury and Sheldon),[1] has been described from the lower Miocene Quebradillas limestone of Porto Rico. It is less elongate than *B. donacia* and has more ribs.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 61628).

Barbatia (Diluvarca) microtera, new species.

(Plate 5, Figures 12, 13.)

Scapharca (Argina) tolepia Dall (part), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 649–650, not plate 33, figs. 7, 8.

The following is a description of this species:

Shell small, inflated, greatest inflation and greatest height of shell behind middle; right valve smaller, more rounded, its posterior end lower than in left; umbos full, broad, medially grooved, lying at about anterior third of length; left valve sculptured with 36 to 38 strong ribs; anterior and median ribs subrounded, separated by narrower interspaces, and bearing beads connected across interspaces by threads; posterior ribs lower, flatter, separated by interspaces of almost the same width, smooth or inconspicuously beaded; right valve sculptured with 28 to 30 obscurely beaded ribs separated by deeply channeled interspaces of the same width or slightly wider; cardinal area very narrow; hinge consisting of two sets of teeth which are not interrupted, the shorter anterior series comprising vertical and slightly oblique teeth, the longer posterior series consisting of more oblique teeth; margin of valve deeply fluted.

Length 6.1 mm.; height 5.9 mm.; diameter (left valve) 1.8 mm.; length of hinge 4 mm.

This species closely resembles very young shells of the Dominican species *B. tolepia* (Dall), but is more rounded and has more numerous ribs.

The type of *Arca tolepia* Dall (U. S. Nat. Mus. No. 113801) has the locality label "Potrero, Rio Amina, St. Domingo." The locality given for the published figure in the explanation of the plate, "Bowden, Jamaica," is incorrect. *Arca tolepia* is the species to which

[1] Comparison based on figures.

Maury later gave the name *Scapharca arthurpennelli.* It has the cardinal area and hinge of small species of *Diluvarca,* but the shape suggests the group *Argina* Gray. This species is confined to the Cercado formation according to the collections of both the Maury and U. S. Geological Survey parties.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352760).

Barbatia (Diluvarca) opthanta, new species.

(Plate 5, Figs. 14, 15.)

The following is a description of this species:

Shell small, cardioid, height exceeding length, decidedly inflated, posterior end higher, moderately inequilateral; left valve larger and more inflated than right, and having higher umbo; dorsal margins short; base descending toward posterior end; umbos high, full, subcentral; sculpture consisting of 26 to 28 ribs, conspicuously beaded on left valve except on umbo, but the right valve has only a few ribs beaded at the anterior end; cardinal area narrow behind umbo, shorter and wider in front of umbo, part behind umbo bearing 2 almost horizontal ligament grooves; inner margin of valve deeply fluted.

Length 7.5 mm.; height 7.8 mm.; diameter (left valve) 3.5 mm.; length of hinge 4.5 mm.

This small species is remarkably similar to very young shells of the Dominican species *B. corcupidonis* (Maury), which is confined to the Cercado formation in the Dominican Republic. The Bowden shells seem to be full grown, as they have a wider cardinal area and heavier hinge than shells of the Dominican species of the same size; in addition, the umbos of the Bowden species are slightly narrower and the number of ribs is greater.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352761).

Genus FOSSULARCA Cossmann.

Subgenus FOSSULARCA s. s.

Cossmann, 1887, Catalogue Illustré des Coquilles Fossiles de l'Eocène des Environs de Paris, part 2, p. 142.

Type (by original designation).—Arca quadrilatera Lamarck. Eocene, Paris Basin.

The following is a description of the genus *Fossularca* s. s.:

Shell small, subquadrate, moderately inequilateral; umbos high; sculpture consisting of fine radial ribs crossed by conspicuous growth-lines; cardinal area narrow, bearing under umbo a small triangular ligament area marked by vertical grooves; remainder of cardinal area bearing faint longitudinal striations; hinge consisting of a short series of oblique anterior teeth separated by a gap from a longer series of oblique posterior teeth; posterior muscle-scar larger than anterior, inner edge of both muscle-scars extending out as a thin shelf; ventral margin of valve smooth or finely fluted.

The triangular ligament area is a characteristic feature of this genus. Cossmann[1] has described a separate section *Galactella* with

[1] In M. Cossmann and A. Peyrot. Conch. Néog. de l'Aquitaine, vol. 2, part 1, p. 192. 1912.

the living European species *Arca lactea* Linné as the type. The ligament area of *A. lactea* is larger than in *A. quadrilatera,* but the size of the ligament area seems to be a variable feature. In the living American *A. adamsi* Dall it is narrower than in *A. lactea.* The separation of the section *Galactella* seems unwarranted.

Stephenson,[1] who has recently called attention to the similarity of *Fossularca* and *Striarca* Conrad (type, *Arca centenaria* Say), regards the two groups as representing the same generic form. They have similar cardinal areas and muscle-scars, but *Fossularca* has two distinct series of teeth separated by an edentulous gap under the narrow ligament area, and this gap is not due to the downward extension of the ligament area. In *Striarca* the teeth are not interrupted and are not clearly divided into two series. This fundamental hinge difference combined with the geologic history of the groups seems to warrant the retention of *Fossularca* as a separate genus.

Fossularca first appears in Eocene deposits in Europe. It is not certainly recorded in American before lower Miocene time. The few living species inhabit the warm and temperate seas.

Fossularca (Fossularca) adamsi sawkinsi, new subspecies.

(Plate 5, Figs. 16, 17.)

Barbatia (Fossularca) adamsi (Shuttleworth) Smith, Dall, (part) 1898, Trans. Wagner Free Inst. Sci., Philadelphia, vol. 3, part 4, pp. 629–630.

Arca adamsi (Shuttleworth) Smith, Sheldon (part) 1916, Paleontographica Americana, vol. 1, p. 22, not plate 4, figs. 16 to 18, plate 5, fig. 1.

The following is a description of this subspecies:

Shell small, moderately inflated, subtrapezoidal, slightly inequilateral; ventral margin slightly contracted medially; posterior ridge low and broad; umbos relatively low, broad, lying slightly in front of middle; sculpture consisting of "blisters" more or less connected radially and concentrically, forming a delicate cancellate sculpture; beneath the blisters, which are partially or even entirely removed, are faint slightly elevated radial and concentric threads, and irregularly spaced growth lines; cardinal area narrow, excavated, ligament seated on a narrow subumbonal triangular area; teeth in two series separated by a narrow subumbonal edentulous space; about 15 in the posterior series and 8 in the anterior; muscular impressions bounded by raised ridges converging toward umbo; inner margin of valve usually smooth.

Length 8.5 mm.; height 5.3 mm.; diameter (left valve) 1.8 mm.

The Bowden shells closely resemble the living east coast and West Indian *F. adamsi adamsi* (Dall), but are smaller and have a less deeply emarginate ventral margin, narrower ligament area and correspondingly narrower edentulous gap in the hinge. *F. adamsi adamsi* has been reported from the American mainland from beds ranging in age from lower Miocene to Quaternary.

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[1] L. W. Stephenson. North Carolina Geological and Economic Survey, vol. 5, part 1 pp. 108–110. 1923.

Recent specimens apparently were early distributed under the manuscript name of *A. adamsi* Shuttleworth, but Dall[1] was the first to publish the name accompanied by a description, as Gardner[2] has shown. Smith,[3] to whom the species usually is assigned, published his description two years later.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352762).

Subgenus OVALARCA, new subgenus.

Type.—Barbatia (Fossularca?) ovalina Dall. Miocene, Jamaica.

The following is a description of the subgenus *Ovalarca*:

Shell very small, ovate, strongly inflated, strongly inequilateral; sculpture consisting of fine concentric rugae and obscure distant radials; cardinal area very narrow, bearing a small, deep triangular ligament area under the umbo; hinge nuculoid, consisting of an anterior and posterior series, the posterior series longer, the two series separated by an edentulous subumbonal gap; muscle-scars high up in shell, posterior scar larger than anterior, inner edge of both scars raised; ventral margin of valve smooth.

The subumbonal triangular ligament area suggests that *Ovalarca* is similar to *Fossularca* s. s., but the cardinal area is narrower and all other features are different. According to Smith, the type of *Lissarca,*[4] has more anterior umbos, more numerous teeth, and a fluted ventral margin. Suter[5] places *Lissarca* in the family Limopsidae.

The type is the only known *Ovalarca.*

Fossularca (Ovalarca) ovalina (Dall).

(Plate 5, Figures 18 to 21.)

Barbatia (Fossularca?) ovalina Dall. 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 630, plate 32, fig. 18. Sheldon, 1916, Paleontographica Americana, vol. 1, p. 22, plate 5, fig. 2.

The following is the original description of this species:

Shell minute, solid, ovate, with rather inflated valves; beaks low in the anterior fourth, prosogyrate; cardinal area short, narrow, smooth, or longitudinally striate, the part occupied by the ligament forming a small excavated triangle with the apex at the beak in each valve; surface nearly smooth, sculpture of faint, irregular, concentric lines, crossed by still fainter sparse radiations which are not pronounced enough to modify the surface; inner margin of the valves smooth; muscular impressions large; hinge short with about 3 crowded anterior and 4 oblique posterior teeth, the two series separated by a wide gap below the ligament. Lon. 3.2, alt. 2.5, diam. 2 mm.

Type locality.—Bowden, Jamaica.

Two right valves of this species are in the Johns Hopkins University collection, and in the National Museum collection there is a left

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[1] W. H. Dall. Bull. Mus. Com. Zool. Harvard, vol. 12, p. 243. 1886.
[2] J. A. Gardner. MS.
[3] E. A. Smith. Jour. Linn. Soc. London, Zool., vol. 20, p. 499, plate 30, figs. 6, 6*a*. 1888.
[4] E. A. Smith. Zoology of the Transit of Venus Expedition, Mollusca, p. 19, plate 9, fig. 17. 1877. *Type (by monotypy).—Arca (Lissarca) rubrofusca* Smith. Recent, Kerguelen Island.
[5] H. Suter. Man. New Zealand Moll., p. 853. 1913.

valve in addition to the holotype. The hinge has 4 anterior and 5 posterior teeth.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135761).

Genus BATHYARCA Kobelt.

Kobelt, 1891, Systematisches Conchylien-Cabinet von Martini und Chemnitz, vol. 8, part 2; Die Gattung *Arca L.*, pp. 213–214.

Type (by original designation).—Arca pectunculoides Scacchi. Recent, seas of Europe.

The following is a description of the genus *Bathyarca*:

Shell minute, subglobose, inequivalve, left larger than right; sculpture consisting of fine radial and concentric threads, usually slightly discrepant on the two valves; cardinal area very narrow, widening in front of umbo; ligament grooves confined to a small area at posterior end of cardinal area; hinge consisting of two short series of very oblique teeth; margin of valve faintly fluted.

The ligament is confined to a small area back of the umbo like in small Barbatias. The hinge is more like that of *Cucullaria* than like any of the Arcas.

The living species of *Bathyarca* are confined to relatively deep water. West Indian and Atlantic coast American Tertiary and living species—except *Bathyarca spenceri* (Dall), a Miocene species from the Isthmus of Tehuantepec, Mexico—are very small, like the type species. *Bathyarca pompholyx* Dall, a living species from off the coast of California, the Galapagos Islands, and the mid-Pacific, is relatively gigantic. Cossmann has suggested that *Arca lissa* Bayan (=*A. laevigata* Caillat), an Eocene species from the Paris Basin, is an ancestral *Bathyarca.*

Bathyarca hendersoni (Dall).

(Plate 6, Figures 1 to 3.)

Scapharca (Bathyarca) hendersoni Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 653, plate 33, fig. 9. Sheldon, 1916, Paleontographica Americana, vol. 1, pp. 63–64, plate 16, fig. 1.

The following is the original description of this species:

Shell very small, much inflated, the hinge-line as long as the shell, which is of a rounded triangular form, with rather prominent prosocoelous beaks; left valve with fine, elevated rounded concentric lines, crossed by closer, less prominent, and finer radial lines; in the right valve, as usual in this section of the genus, the radial sculpture predominates over the concentric, the latter though present being inconspicuous; cardinal area moderately wide, the beaks being nearly medial, the surface of the area longitudinally striated; hinge with about five nearly vertical anterior teeth separated by a wide unarmed gap from six or seven smaller, more oblique posterior teeth; margin of the valves thin, entire, or microscopically crenulated; the inner edges of the adductor scars slightly raised above the inner surface of the valve. Lon. 2, alt. 2, diam. 2 mm.

Type locality.—Bowden, Jamaica.

In the Duerden collection there are only a few valves of this small species, but there is a surprisingly large number in the Aldrich collection. The shell is much higher at the posterior end, as the anterior margin descends steeply. The posterior margin is only gently curved. The greatest inflation is in the median posterior part. For the size of the shell the umbos are very broad; they are placed slightly in front of the middle. On some shells a very faint groove is visible on the umbo. When continued the groove is on the anterior side of the median line of the shell and slightly insinuates the ventral margin. As usual in the genus, the left valve is larger. The convexity of left valves is variable. The less convex shells have a narrower cardinal area and more oblique anterior teeth.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135760).

Family LIMOPSIDAE.

Genus LIMOPSIS Sassi.

Subgenus LIMOPSIS s. s.

Sassi, 1827, Giornale ligustico di scienze, letters, ed arti, year 1, p. 476.

Type.—Arca aurita Brocchi. Miocene and Pliocene, Italy.

The following is a description of the subgenus *Limopsis* s. s.:

Shell medium-sized, obliquely ovate, strongly inflated; umbos high, subcentral; sculpture consisting of irregularly spaced concentric undulations and obscure narrow radial furrows, usually absent on central part of valve; cardinal area narrow, amphidetic, interrupted by the shallow triangular chondrophore; hinge consisting of an uninterrupted series of teeth, posterior teeth more numerous than anterior, outermost posterior teeth more horizontal than outermost anterior, median teeth vertical, shorter than anterior and posterior ones; posterior muscle-scar larger than anterior; inner edge of margin of valve smooth.

There are no Bowden species of *Limopsis* s. s.

Subgenus PECTUNCULINA d'Orbigny.

d'Orbigny, 1843, Paléontologie Française: Terrain Crétacé, vol. 3, p. 182.

Type (by subsequent designation, Sacco, 1898.)—Pectunculus scalaris Sowerby. Eocene, London basin.

The following is a description of the subgenus *Pectunculina*:

Shell medium-sized, obliquely ovate, moderately inflated; umbos moderately high, subcentral; sculpture reticulate; cardinal area like *Limopsis* s. s.; hinge interrupted under chondrophore, posterior teeth more horizontal than anterior; posterior muscle-scar bounded on anterior side by an obscure radial ray that becomes stronger toward ventral margin; inner edge of margin of valve finely fluted.

The reticulate sculpture, interrupted hinge, and fluted inner margin separate *Pectunculina* from *Limopsis* s. s. Tertiary and living species

of *Pectunculina* are widely distributed in the warm seas. Some of the Recent species live in deep water.

Key to Bowden species of Pectunculina.

Sculpture strongly reticulate..... *L. (P.) ovalis silova*
Sculpture consisting of widely spaced concentric threads and low radial riblets..... *L. (P.) jamaicensis*

Limopsis (Pectunculina) ovalis silova, new subspecies.

(Plate 6, Figures 4, 5.)

The following is a description of this subspecies:

Shell small, subovate, moderately convex, subequilateral; umbos prominent, strongly incurved; sculpture consisting of almost equally strong radial and concentric riblets; cardinal area moderately narrow; in front of the chondrophore are 5 or 6 almost vertical teeth, the inner tooth placed under the chondrophore, a short edentulous internal separates the anterior series from the 4 or 5 more horizontal teeth in the posterior series; muscle-scars obscure; inner edge of the anterior margin of the valve finely fluted, the fluting disappearing on the posterior margin.

Length 5.8 mm.; height 6.2 mm.; diameter (left valve) 1.5 mm.

L. ovalis ovalis Gabb was described from Miocene beds in the Dominican Republic. It reaches a slightly larger size than the Bowden subspecies and is slightly less oblique. On the type of Gabb's species the concentric sculpture is stronger than the radial; two smaller shells in the Gabb collection have a sculpture closely resembling that of *L. ovalis silova,* but the radial riblets are more widely spaced. *L. hatoviejonis* Maury apparently is the same as the smaller shells included by Gabb under *L. ovalis.*

Guppy has described a similar *Limopsis, L. subangularis,* from beds probably of Miocene age at Pointapier, Trinidad. It is so similar to *L. ovalis* that it might be considered a subspecies. The Trinidad subspecies is smaller than *L. ovalis silova,* slightly more oblique, less convex, and has concentric sculpture that is usually stronger than the radial. *L. ovalis ovalis, L. ovalis silova,* and *L. ovalis subangularis,* in the order named, constitute a series wherein the shell grades from relatively large and slightly oblique to small and more decidedly oblique, but the differences are slight.

The living West Indian *Limopsis* that goes under the name of *L. minuta* (Philippi) is more oblique than *L. ovalis silova,* more convex, and more finely sculptured.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352765).

Limopsis (Pectunculina) jamaicensis, new species.

(Plate 6, Figures 6, 7.)

The following is a description of this species:

Shell minute, heavy for the size, suborbicular; umbos relatively prominent; sculpture consisting of fine, widely separated concentric lamellae

(interspaces broadest in the central part of shell), and less prominent, more closely spaced radial riblets; the concentric lamellae are thin and worn, except on the radial riblets, where they are heavier; posterior part of the narrow cardinal area longer than anterior; teeth in two series, separated by a relatively wide edentulous area, the 3 teeth of the anterior series heavy, vertical, and placed near dorsal margin; the 3 posterior teeth smaller, almost horizontal, lying farther from dorsal margin, and placed one below the other in a gently curved series; inner margin of valve faintly fluted, fluting coarsest at posterior end of ventral margin.

Length 2 mm.; height 2.2 mm.; diameter (left valve) 0.8 mm.

This species is known only from the holotype, a left valve. It resembles *L. monilis* Olsson,[1] from the Miocene of Costa Rica, but has less conspicuous sculpture.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352766).

Superfamily PTERIACEA.

Family PINNIDAE.

Genus PINNA Linné.

Linné, 1758, Systema Naturae, ed. 10, p. 707.

Type (by subsequent designation, Gray, 1847.)—Pinna rudis Linné. Recent, West Indies (?).

The following is a description of the genus *Pinna*:

Shell large, thin, elongate trigonal, gaping at posterior end; umbos terminal; exterior bearing a longitudinal groove at the angular shoulder; sculpture consisting of longitudinal ridges; hinge edentulous; inner nacreous layer cleft opposite shoulder except near umbo, where there is a narrow ridge.

Tertiary and living species of *Pinna* have a wide distribution. The living species inhabit the tropical and temperate seas.

Pinna refurca, new species.

(Plate 6, Figure 8.)

The following is a description of this species:

Shell small, slender, moderately thick, strongly inflated; shoulder of shell subangular to rounded, lying nearer dorsal margin; dorsal surface almost flat, ventral surface gently arched; dorsal and ventral margins straight, diverging at an angle of about 25°; external surface bearing a relatively deep grove beginning near anterior end and extending along shoulder of shell; dorsal part of shell sculptured with 5 longitudinal ridges, excluding the ridge adjacent to the groove; upper half or more of ventral part of shell sculptured with 3 more irregular, broader, lower ridges, followed (toward the ventral margin) by oblique, obscure undulations, diverging slightly from the margin and terminating abruptly at the longitudinal ridges; inner surface of umbonal part of valve bearing a narrow ridge corresponding to the external groove.

Length about 65 mm. (estimated); height 17.5 mm.; diameter (left valve) 7.8 mm.

[1] Comparison based on figures.

This species is described from two fragments representing the middle part of a left valve (holotype) and a small almost complete right valve. On the larger fragment most of the posterior muscle-scar is visible. It is large, longitudinally elongate, convexly rounded posteriorly, and ventral in position.

The Caloosahatchee species (*P. caloosaënsis* Dall) is heavier, more symmetrical, and has a broader, higher internal ridge and different sculpture. The living West Indian species known as *P. rudis* is thinner, has a less conspicuous external groove and internal ridge, and different sculpture. These species reach a larger size than the Bowden species.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352767).

Genus ATRINA Gray.

Gray, 1847, Proceedings Zoological Society of London, part 15, p. 190.

Type (*by original designation*).—*Pinna nigra* Chemnitz. Recent, Indo-Pacific.

The following is a description of the genus *Atrina*:

Shell large, thin, elongate trigonal to triangular, gaping at posterior end; umbos terminal; sculpture consisting of longitudinal ridges, smooth or ornamented with spines; hinge edentulous.

Atrina is widely distributed in the Tertiary and living faunas of the warm and temperate seas. It has often been confused with *Pinna*.

Atrina species.

(Plate 6, Figure 9.)

The genus *Atrina* is represented by a broken right valve. The ventral margin, apical and extreme posterior parts are missing, so that the outline is not known, although the shell appears to be elongate and slender; the dorsal margin is straight and slightly reflexed. Most of the external surface is sculptured with relatively coarse oblique undulations upon which are superimposed finer oblique ridges; but along the ventral edge, which may be some distance from the ventral margin, there are indications of at least one longitudinal ridge.

Family ISOGNOMONIDAE.

Genus ISOGNOMON Solander.

Solander, 1786, A Catalogue of the Portland Museum, p. 9.[1]

Type (*by tautonymy*).—*Ostrea isognomon* Linné. Recent, Indo-Pacific.

The following is a description of the genus *Isognomon*:

Shell reaching a large size, obliquely subquadrate, posterior end auriculate or rounded; anterior margin insinuated by a narrow byssal gape near dorsal

[1] This citation is given on the authority of Iredale (Proc. Mal. Soc. London, vol. 11, p. 303, 1915).

margin; ligament area bearing numerous parallel grooves perpendicular to dorsal margin of valve; interior nacreous.

The American Tertiary and living species are not so strongly auriculate as the type species. This genus, also known as *Perna* and *Melina,* is found in virtually all Tertiary and living faunas of the warm seas. In Europe it is represented by several Tertiary species, but there are no living species in the European seas.

Isognomon species.

(Plate 6, Figure 10.)

The genus *Isognomon* is represented by a small fragment of an apparently adult valve and an almost perfect young valve. The larger shell is very thick in the umbonal region; the byssal notch is long, abruptly indented; the ligament grooves are long, diverging at a slight angle from the byssal notch, and the raised intervals between the grooves are narrower than the grooves; the sculpture consists of numerous fine concentric striations, reinforced at intervals by incrementals. The small valve is subquadrate in outline; its anterior lateral margin is flexed inward, and the byssal notch is indistinct; the 4 ligament grooves are relatively wide, and separated by much narrower ridges.

Family PTERIIDAE.

Genus PTERIA Scopoli.

Scopoli, 1777, Introductio ad Historiam naturalem, sistens genera Lapidum, Plantarum et Animalium hactenus detecta, caracteribus essentialibus donata, in tribis divisa, subinde ad leges Naturae, p. 397.

Type (*by monotypy.*)—*Mytilus hirundo* Linné. Recent, Mediterranean Sea.

The following is a description of the genus *Pteria*:

Shell of varying size, nacreous, posterior and anterior ends auriculate; anterior margin below auricle insinuated by a narrow byssal gape; sculpture weak; cardinal area narrow, almost as long as dorsal margin of valve; right and left valve bearing 1 or 2 small cardinal teeth fitting into shallow sockets, and a long posterior lateral lamella.

Pteria has a long history, as it is abundant in late Paleozoic and Mesozoic deposits. The living species have a wide distribution in warm and temperate seas.

Pteria inornata (Gabb).

(Plate 6, Figure 11.)

Avicula inornata Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 253.
Pteria inornata (Gabb), Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 669. Maury, 1917, Bull. Amer. Paleontology, vol. 5, pp. 345–346, plate 52, fig. 14. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 408, plate 42, figs. 6, 7.

The following is the original description of this species:

Shell small, oblique, convex; anterior ear small, triangular, posterior moderately long, acuminate; surface smooth, without ornament. Length 1 inch.

Type locality.—Dominican Republic.

The following is a description of Bowden specimens of this species:

Shell small, moderately and broadly inflated along a diagonal from the umbo to the posterior ventral margin, greatest inflation medial and rising abruptly from anterior margin, descending more gently toward posterior and ventral margins; dorsal margin moderately long, straight; umbo low, scarcely rising above dorsal margin; anterior auricle small, triangular, depressed, set off from rest of shell by a ledge along line of narrow byssal sinus; surface of the shell smooth except for obscure sinuous incrementals on anterior auricle; cardinal area narrow, long, extending almost to ends of dorsal margin; hinge of right valve bearing a socket placed slightly in front of umbo and a lateral lamella near posterior end of dorsal margin.

Length about 20 mm. (estimated); height 11 mm.; diameter (right valve) 3.2 mm.

This species is represented by a few broken valves. The valve figured is a little less inflated and has a wider posterior auricle than most shells from the Cercado formation of the Dominican Republic, which carries many broken specimens.

Other localities.—Cercado formation (lower Miocene), Dominican Republic.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 2748).

Superfamily OSTRACEA.

Family OSTREIDAE.

Genus OSTREA Linné.

Subgenus OSTREA s. s.

Section OSTREA s. s.

Bolten, 1798, Museum Boltenianum, part 2, p. 168.

Type (by subsequent designation, Gray, 1847).—Ostrea edulis Linné. Recent, seas of Europe.

The following is a description of the section *Ostrea* s. s.:

Shell medium-sized, irregular in outline, inequilateral; left valve larger, attached, convex; right valve flat; left valve sculptured with numerous low folds extending to margin of valve; right valve lamellar; hinge edentulous; resilium seated on a longitudinal groove on left valve corresponding to a ridge on right valve, ligament occupying an area on both sides of resilium; margins of valve below ligament area minutely corrugated.

The small oysters from the Bowden formation seem to be similar to the type of the section *Lopha.*

Section LOPHA Bolten.

Bolten, 1798, Museum Boltenianum, part 2, p. 168.

Type (by subsequent designation, Dall, 1898).—Ostrea cristagalli Gmelin. Recent, Indo-Pacific.

The following is a description of the section *Lopha*:

Shell medium-sized, subequivalve, subovate to falcate; sculpture of both valves similar, consisting of deep radial folds; inner margin of valve minutely pustolose; groove for resilium on left valve wide and very shallow.

Oysters of the section *Lopha* are common in the tropical seas.

Key to the Bowden species of Lopha.

Folds subangular, 3 to 5..... *O. (L.) paramegodon*
Folds angular, 5 to 7..... *O. (L.) guppyi*
Folds subrounded, 15 to 20..... *O. (L.) folioides*

Ostrea (Lopha) paramegodon, new species.

(Plate 6, Figures 12 to 14.)

Ostrea megodon Dall (part, not Hanley) 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 685–686.

The following is a description of this species:

Shell small, thin, subequivalve; both valves compressed or slightly convex; outline variable, elongate, longitudinally subovate to subfalcate; left valve bearing 3 to 5 broad irregular subangular to rounded folds, most prominent at ventral margin and extending only a short distance from margin; depressions between folds broader, thinner, but less angular than folds; right valve bearing similar but less prominent folds, or irregularly warped; neither valve has definite concentric sculpture except inconspicuous, usually non-laminated incrementals; ligament area wide, oblique, bearing on the left valve a broad, shallow median depression; submargins finely pustulate; muscle-scar relatively large, longitudinally subelliptical to broadly subovate in outline, the anterior dorsal margin deeply emarginate.

A longitudinally subovate right valve: length 26.5 mm.; height 40.5 mm. A subfalcate right valve: dorsal length 17 mm.; ventral length 27.5 mm.; height 31.5 mm.

O. paramegodon resembles *O. megodon* Hanley, a living species described from Peru and recorded as far north as Lower California, but is much smaller, less curved, and has shallower folds. The Bowden species seems to more closely resemble this living West Coast species than any living West Indian species. The somewhat curved *O. pauciplicata* Dall, from the Oak Grove sand of Florida, has a larger number of folds and regular concentric lamellae.

A similar species from the Gurabo formation of the Dominican Republic, described by Maury as *O. megodon,* is more curved than *O. paramegodon* and has deeper folds; aside from the difference in size it is more like the living *O. megodon.* The Miocene species from Costa Rica, recorded by Olsson as *O. megodon,* is more curved than the Bowden species and has more numerous folds.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352771); paratype (right valve, U. S. Nat. Mus. No. 352772).

Ostrea (Lopha) guppyi, new species.

(Plate 7, Figures 1, 2.)

Ostrea haitensis Dall (part, not Sowerby), 1898, Trans. Wagner Free Inst. Sci., Philadelphia, vol. 3, pt. 4, p. 685.

The following is a description of this species:

Shell small, width not exceeding 30 mm.; thin or slightly thickened, compressed or slightly convex; outline varying from longitudinally ovate to broadly ovate or even subcircular; left valve bearing 5 to 7 strong, narrow, usually sharply angular folds, some rising near the umbo and becoming progressively prominent toward margin; on some shells secondary folds extend a short distance from the margin; interspaces between folds deep and sharply angular; concentric sculpture consisting of lamellae, superimposed on the folds and most prominent near ventral margin; right valve almost smooth or bearing folds similar to those on the left; submargins usually corrugated; muscle-scar large for the size of the shell, subelliptical to subcircular in outline; inner margin cf the valve bearing minute pustules.

Length 28 mm.; height 35 mm.

O. haitensis Sowerby, which in the Dominican Republic is confined to the Gurabo formation, has a very large, heavy shell. Adult shells are 150 mm. high and 140 mm. wide. The Bowden shells have much deeper folds than young Dominican shells of the same size. The Bowden species more resembles unattached valves of the living West Indian mangrove oyster, *O. folium* Linné, but is smaller and has fewer folds. *O. guppyi* also resembles *O. costaricensis* Olsson,[1] a Miocene species from Costa Rica, but is smaller and has deeper and wider folds.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352773).

Ostrea (Lopha) folioides, new species.

(Plate 7, Figures 3 to 5.)

The following is a description of this species:

Shell small and thin; outline variable, longitudinal subovate to elongate and narrow; left valve usually more convex than right; margins of valves sculptured with 15 to 20 sharp, usually subrounded folds extending only a short distance from the margin, central part of shell almost smooth or bearing curved clasping spines; concentric sculpture consisting of inconspicuous incremental lamellae; ligament area small, flattened; muscle-scar small, subelliptical to subcircular in outline; inner margin of shell, or only parts of margin, bearing small pustules.

Length 11 mm.; height 34 mm.

O. folioides superficially resembles the living West Indian mangrove oyster, *O. folium* Linné, as some of the shells have clasping spines. None of the Bowden shells is so large as *O. folium* and all are less deeply folded than living shells of the same size.

Only the shells that were attached to twigs or roots have clasping spines. All the shells that are referred to this species have numerous

[1] Comparison based on figures.

small marginal folds. The folds are smaller and more numerous than in *O. guppyi* and extend only a short distance from the margin of the shell.

A similar species was collected in the Dominican Republic from the Cercado formation on Rio Mao at station 8525.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352774).

Superfamily PECTINACEA.

Family PECTINIDAE.

Genus PECTEN Müller.

Subgenus PECTEN s. s.

Müller, 1776, Zoologiae Danicae, p. 248.

Type (by subsequent designation, Gray, 1847).—Ostrea maxima Linné. Recent, northern seas of Europe.

The following is a description of the subgenus *Pecten* s. s.:

Shell reaching a large size, equilateral, inequivalve; right valve moderately inflated, adult left valve slightly inflated, young left valve concave; auricles moderately large, subequal, convex on right valve, concave on left; cardinal edge of auricles of right valve bent downward; byssal notch narrow; radial sculpture consisting of wide rounded ribs and narrow threads on both ribs and interspaces; concentric sculpture consisting of fine incremental lamellae; chondrophore large, deep, flanked by 3 or 4 pairs of cardinal crura.

Pecten s. s. was widely distributed in late Mesozoic time. The living species have an extensive geographic range.

The Bowden species referred to this subgenus lacks the radial threads of the type species.

Pecten (Pecten) barretti, new species.

(Plate 7, Figures 6, 7.)

Pecten (Pecten) soror Dall (part, not Gabb), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 712.

The following is a description of this species:

Shell large; dorsal margins slightly concave, diverging at an angle of about 95°; right valve strongly inflated, sculptured with 19 to 22 high, almost square ribs, their edges and tops slightly rounded, separated by narrower, deeply channeled interspaces; in the interspaces and on the flanks of the ribs are obscure, fine, slightly raised concentric lamellae; left valve slightly concave, sculptured with the same number of narrower square ribs, and deep, flat interspaces of the same width or slightly wider; concentric lamellae more prominent than on right valve and occasionally extending across ribs, but less conspicuous on ribs than in interspaces; submargins relatively wide and forming a deep ledge on left valve; auricles subequal, sculptured with weak radial ribs and fine concentric lamellae; interior ventral margin deeply fluted.

Left valve: length 50 mm.; height 45 mm.; length of hinge 25 mm. Immature right valve: length 32 mm.; height 29.5 mm.; diameter 7 mm.; length of hinge about 13 mm.

P. barretti resembles *P. soror* (Gabb), described from the Dominican Republic, where it has been collected from both the Cercado and Gurabo formations. The Bowden species has less concave dorsal margins; the right valve has fewer and more rectangular ribs, narrower interspaces, and less conspicuous concentric lamellae; the left valve has more rectangular ribs and more strongly sculptured auricles.

None of the valves of *P. barretti* is in attached position and the right and left valves here described may possibly belong to different species.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352776); paratype (left valve, U. S. Nat. Mus. No. 352777).

Subgenus EUVOLA Dall.

Dall, 1898, Transactions Wagner Free Institute of Science of Philadelphia, vol. 3, part 4, p. 694.

Type (by original designation).—Ostrea ziczac Linné. Recent, West Indies.

The following is a description of the subgenus *Euvola*:

Shell reaching a large size, equilateral, inequivalve; right valve strongly inflated, sculptured with narrow, shallow radial grooves; left valve concave, sculptured with radial grooves and concentric threads; auricles large; byssal notch narrow; chondrophore large, deep, flanked by a pair of cardinal crura near the cardinal margin.

Euvola differs from *Pecten* s. s. in having a more inflated right valve, weaker radial sculpture, and only one pair of cardinal crura.

Euvola is a tropical and subtropical group of Pectens. The earliest American species are from deposits of Miocene age.

Pecten (Euvola) bowdenensis Dall.

(Plate 7, Figures 8, 9.)

Pecten (Euvola) bowdenensis Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 713, plate 29, fig. 1. ? Böse, 1906, Bol. Soc. Geol. Mexicana, vol. 1, p. 143 (list). ? Böse, 1906, Bol. Inst. Geol. Mexico, No. 22, p. 27, plate 1, figs. 8, 10.

The following is the original description of this species:

Shell resembling *P. ziczac* L. in the right valve, with about 23 obsolete smooth ribs separated by impressed lines; right valve very convex; ears subequal, smooth, notch narrow, deep; left valve with 17 low, rounded ribs separated by wider, squarely impressed interspaces; submargins wide, smooth; disk moderately concave; ears subequal, smooth, concavely arched; interior margin of the base with paired lirae, the pairs separated by deeper channels; cardinal crura obvious. Alt., 43; lat., 44.5 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell thin, width and length almost equal, hinge-line approximately equal to half the width of shell; dorsal margins long, slightly concave, diverging

at an angle of about 105°; outline of ventral half evenly semicircular; convex right valve bearing shallow radial grooves, the surface more or less polished and bearing very faint, irregularly spaced incremental lamellae, usually slightly more conspicuous and more regularly spaced on submargins and on irregular somewhat worn areas on disk; umbonal part of concave left valve almost smooth, middle of the interspaces between low ribs usually slightly raised; the fine concentric threads more conspicuous than on right valve and more regularly spaced; auricles on both valves subequal and smooth, except for fine incrementals, which are sinuous on the right anterior auricle; on interior of left valve paired lirae are visible for only a short distance from the margin, interval between two members of a pair more deeply channeled than interval between pairs; on right valve lirae extend further up toward the umbo and the interval between two pairs more deeply channeled than interval between two members of a pair.

A right valve: length 44 mm.; height 45 mm.; diameter 16 mm.; length of hinge 21 mm. A left valve: length 47 mm.; height 46.2 mm.; diameter 6 mm.; length of hinge 22.5 mm.

P. bowdenensis closely resembles the living West Indian species *P. ziczac* (Linné), but the right valve of the living species is not quite so inflated and the left valve is sculptured with more numerous ribs, separated by narrow grooves. *P. medius* Lamarck, is more strongly ribbed. The Costa Rican Miocene (?) species *P. limonensis* Dall is smaller and has weaker sculpture. The interspaces of the left valves which Böse described from Miocene beds in Tuxtepec, Mexico, seem to be flatter and deeper than in *P. bowdenensis*.[1]

Type material.—9 cotypes (1 right and 8 left valves, 2 of which represent *Pecten (Pecten) barretti,* U. S. Nat. Mus. No. 135782).

Genus CHLAMYS Bolten.

Subgenus CHLAMYS s. s.

Bolten, 1798, Museum Boltenianum, pt. 2, p. 161.

Type (by subsequent designation, Dall, 1898).—Pecten islandicus Müller. Recent, seas of Europe.

The following is a description of the subgenus *Chlamys* s. s.:

Shell medium-sized, inequilateral, dorsal margins sloping steeply, left valve a little more inflated than right; radial sculpture consisting of narrow ribs, an increasing number of secondary radials added as the shell grows; concentric sculpture consisting of more or less scaly lamellae; auricles unequal, anterior ones larger, right anterior auricle deeply insinuated, producing a conspicuous byssal gape, margin of valve below auricle bearing a ctenolium; cardinal margin of auricles of both valves bent inward, the right valve more strongly; chondrophore moderately deep, flanked by 2 pairs of cardinal crura, the upper crura long, especially the anterior one, the lower short, more oblique, and near the chondrophore.

The steeply sloping dorsal margins and small posterior auricle are characteristic features of the subgenus *Chlamys* s. s. Living species have a cosmopolitan distribution. The tropical species are smaller

[1] Comparison based on figures.

and more brightly colored than the species living in cooler water. Tertiary species were widely distributed, like the living ones.

Key to the Bowden species of Chlamys s. s.

Secondary ribs introduced near middle of shell..... *C.* (*C.*) species
Secondary ribs introduced near ventral margin..... *C.* (*C.*) *vaginulus*
Secondary ribs absent..... *C.* (*C.*) *bellipictus*

Chlamys (Chlamys) species.

(Plate 7, Figure 10.)

The following is a description of this species:

Right valve small, thin, higher than wide, dorsal margins sloping steeply; sculpture consisting of about 12 narrow, rounded ribs; 1 or 2 secondary radials lie in the interspaces, rapidly enlarging toward ventral margin; ribs finely beaded by irregularly spaced concentric lamellae; auricles unequal, sculptured with relatively prominent radials roughened by overriding concentric lamellae.

Length 4 mm.; height 5 mm.; diameter (right valve) 0.5 mm.

This species is represented by a right valve that apparently is not full grown.

Chlamys (Chlamys) vaginulus (Dall).

(Plate 8, Figures 1, 2.)

Pecten (*Chlamys*) *ornatus* Lamarck ? var. *vaginulus* Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 715–716.

Pecten vaginulus Dall, Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 350, plate 60, fig. 7.

The following is the original description of this species:

Seven small valves of a species closely resembling *P. ornatus* were obtained at Bowden; the form and sculpture are practically the same, but the ribs (21 to 25) are single, subequal, and not fasciculated, and are separated by simple narrower interspaces not radially threaded. The young of *ornatus*, as far as observed, seem always to have one or more interstitial riblets. I therefore propose for the present form the varietal name of *vaginulus*, which may be raised to specific rank if the difference is confirmed by the characters of adult specimens.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, thin, subequivalve, suborbicular, height slightly exceeding width, equilateral, excepting auricles, moderately inflated; right valve usually less inflated than left; both valves sculptured with 21 to 25 slender, square to subrounded ribs, separated by narrower interspaces; near the ventral margin of adult shells a fine radial thread lies in the interspaces; in the interspaces and occasionally overriding the ribs are fine, inconspicuous concentric lamellae; submargins without radial sculpture, or sculptured with fine radials, forming a continuous series with those on the disk; hinge long, auricles very unequal, especially on right valve; byssal notch deep and sharply sinuated; both auricles sculptured with irregular radial ribs and

concentric lamellae, sculpture on the anterior auricle coarser and more imbricate.

A right valve: length 11.8 mm.; height 12 mm.; diameter 1.9 mm.; length of hinge 7.5 mm. A left valve: length 12 mm.; height 13 mm.; diameter 2.1 mm.; length of hinge 7.2 mm.

The outline of the shell is variable, as some are more orbicular than others. On some valves the anterior submargin is narrower than the posterior, and has no radial sculpture. The posterior submargin may or may not have radial sculpture. Immature right valves are flat and have unusually long anterior auricles.

This species is smaller and has wider umbos than the living West Indian species *C. ornatus* (Lamarck). The thread in the interspaces is smaller than in the living species and is introduced at a later stage. Maury has recorded *C. vaginulus* Dall from Miocene beds in the Samba Hills, Dominican Republic. A broken valve, apparently *C. vaginulus,* was collected by the U. S. Geological Survey expedition from the Gurabo formation on Rio Yaque del Norte near Santiago (station 8726). The concentric lamellae on the Dominican shell are more crowded and less conspicuous on the ribs.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—7 cotypes (U. S. Nat. Mus. No. 135786).

Chlamys (Chlamys) bellipictus, new species.

(Plate 8, Figure 3.)

The following is a description of this species:

Right valve small, thin, compressed, height slightly exceeding width; dorsal margins long; radial sculpture consisting of 11 low, rounded ribs, separated by wider interspaces, disappearing on dorsal half of shell; concentric sculpture consisting of fine, microscopic concentric threads over entire surface; auricles subequal, right anterior auricle sculptured with radials and superimposed concentric lamellae, scaly along hinge; byssal notch prominent; interior of valve bearing broad radial undulations corresponding to external intercostal spaces; left valve not known.

Length 7 mm.; height 7.5 mm.

This species is represented by a small right valve. Dall has described a similar species, *C. alumensis,* from the Chipola formation; it is more inflated and has more numerous ribs.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352780).

Subgenus AEQUIPECTEN Fisher

Section AEQUIPECTEN s. s.

Fischer, 1887, Manuel de Conchyliologie, p. 944.

Type (by monotypy).—Ostrea opercularis Linné. Recent, seas of Europe.

The following is a description of the section *Aequipecten*:

Shell medium-sized, left valve more inflated than right, umbos narrow; radial sculpture consisting of relatively wide ribs and fine grooves on ribs and interspaces; auricles subequal, cardinal margin of right auricles strongly bent downward, cardinal margin of left auricles not bent; chondrophore wide, shallow, flanked by a pair of upper cardinal crura.

The dorsal margins slope less steeply than in *Chlamys* s. s.; the auricles are subequal; and secondary radials are not intercalated in the interspaces as the shell grows.

Tertiary and living species of *Aequipecten* are widely distributed.

Chlamys (Aequipecten) plurinominis morantensis, new subspecies.
(Plate 8, Figures 4, 5.)

Pecten exasperatus Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 294. Guppy (part, not Sowerby), 1874, Geol. Mag. dec. 2, vol. 1, p. 443 (list).

Pecten (*Aequipecten*) *thetidis* Dall (part, not Sowerby), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 714–715.

The following is a description of this subspecies:

Shell medium-sized, subequivalve, both valves moderately convex, suborbicular; sculpture similar on both valves, consisting of 18 to 20 radial ribs, more or less square on dorsal half of shell, broader and more rounded on ventral half, separated by narrower interspaces; ribs and interspaces on ventral half of shell ornamented with radial rows of short, blunt scales, smaller in the interspaces, inconspicuous on dorsal half of shell, reduced to a single row and often absent in interspaces; submargins sculptured with fine, narrow, irregularly spaced scaly radial ribs; auricles broad, the anterior longer, sculptured with scaly radial ribs of irregular width, wider and higher than those on submargins, on the right anterior auricle the ribs are wider and the scales more prominent; interior of shell bearing paired lirae separated by excavated intervals.

A right valve: length 34.5 mm.; height 34.4 mm.; diameter 8 mm.; length of hinge 23.5 mm. A left valve: length 33.2 mm.; height 34 mm.; diameter 8.8 mm.; length of hinge 24.5 mm.

C. plurinominis morantensis closely resembles *C. plurinominis plurinominis* Pilsbry and Johnson, the type of which is in the Gabb collection from the Dominican Republic. The Dominican species has been collected from both the Cerado and Gurabo formations, but all the large specimens, which are similar to Gabb's specimens, come from the Gurabo formation. The Bowden subspecies has scales that are not so clearly arranged in radial rows and the interspaces near the ventral margin of the shell are narrower.

The Dominican species has been described under a number of names. Gabb and Guppy called it *C. oxygonum* Sowerby; Dall and Maury called it *C. thetidis* Sowerby. No figures accompany Sowerby's descriptions of *C. oxygonum* and *C. thetidis,* both of which were described from the Dominican Republic. There seems to be no doubt about the features of *C. oxygonum,* and specimens in the Gabb collection agree with Sowerby's description of *C. thetidis.* Pilsbry

and Johnson have accordingly renamed the species *P. plurinominis*. *C. thedites* is more inequilateral than *C. plurinominis,* and has higher ribs that have a median groove and are bounded on both sides by radial threads; the radials are roughened by irregularly spaced concentric lamellae.

Cooke has described under the name of *P. thetidis* Sowerby a species from the upper Oligocene limestone of Anguilla that closely resembles *C. plurinominis morantensis,* but the Anguillan species is much smaller and the scales are arranged in prominent radial series near the ventral margin of the valve.

C. plurinominis morantensis is similar to the living West Indian species *C. exasperatus* (Sowerby), but is smaller, more orbicular, less inflated, and has scales that are not so clearly arranged in radial series. It more closely resembles *C. fuscopurpureus* (Conrad), a living species from Florida, but is smaller and has wider and more inflated umbos.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352781); paratype (left valve, U. S. Nat. Mus. No. 352782).

Section PLAGIOCTENIUM Dall.

Dall, 1898, Transactions Wagner Free Institute of Science of Philadelphia, vol. 3, part 4, p. 696.

Type (by original designation).—Pecten ventricosus Sowerby. Recent, Pacific coast of Mexico and Central America.

The following is a description of the section *Plagioctenium*:

Shell reaching a large size, inequilateral, more elongate at posterior end, strongly inflated, right valve more inflated than left, umbos wide; sculpture consisting of flat-topped or rounded ribs, separated by narrower squarely channeled interspaces; looped concentric threads, concave upward, cross the interspaces; auricles long, resembling those of *Aequipecten,* the radial ribs stronger on anterior auricle than on posterior, especially on right valve; cardinal margin of right valve strongly bent downward, as in *Aequipecten;* cardinal crura more slender than in *Aequipecten.*

The valves of *Plagioctenium* are more inequilateral than in *Aequipecten;* the umbos are fuller and wider; the ribs and interspaces have no radial grooves; and the auricles are longer.

Species of *Plagioctenium* are very abundant in American Tertiary and living faunas. They are abundant in other parts of the world, but usually are called *Chlamys* or *Aequipecten.*

Key to the Bowden species of Plagioctenium.

Ribs high, flattened, numbering 17 or 18 on both valves..... *C. (P.) uselmae*
Ribs moderately high, rounded.
  Concentric lamellae strongly elevated in interspaces, ribs numbering 17 on left valve..... *C. (P.) concinnatus*
  Concentric lamellae not strongly elevated in interspaces.
    Ribs, relatively wide, numbering 21 to 23 on both valves..... *C. (P.) ameleus*
    Ribs narrow, numbering 17 or 18 on left valve..... *C. (P.) mansfieldi*
Ribs moderately high, subangular near ventral margin, numbering 22 or 23 on right valve, 18 or 19 on left valve..... *C. (P.) gonioides*

Chlamys (Plagiocetenium) uselmae (Pilsbry and Johnson).

(Plate 8, Figures 6, 7.)

Pecten inaequalis Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 294, plate 18, fig. 6. Guppy (part, not Sowerby), 1874, Geol. Mag. dec. 2, vol. 1, p. 443 (list).

Pecten (Aequipecten) inaequalis Dall (part, not Sowerby), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 714.

Pecten uselmae Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 194. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 412, plate 45, fig. 9.

The following is the original description of this species:

The shell is inequilateral, inequivalve, the left valve is larger, conspicuously surpassing the right throughout the lower margin and ends. It is strongly convex; the right valve weakly so. Sculpture of 17 rounded ribs. In the left valve these are wider than the intervals, which are deeply cut, with concave bottoms, which are closely sculptured with delicate transverse threads. In the right valve the ribs are lower, and not quite as wide as the intervals, in which the transverse striation is often weak. The submargins are smooth. Ears with several ribs. Ctenolium is very short, of 3 teeth, which are small in adult shells. Cardinal crura strong, vertically striate. Length of left valve 28, alt. 27.3, diam 8.25 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell medium-sized, height and width almost equal, posterior side more extended; right valve decidedly inflated, left valve moderately or slightly inflated, compressed toward ventral margin; dorsal margins straight or slightly concave, posterior margin longer and sloping more steeply than anterior; right valve sculptured with 17 or 18 high, broad, more or less polished radial ribs, their tops slightly rounded and their flanks excavated; intercostal spaces narrower than ribs, deeply and squarely channeled, bearing concentric lamellae; ribs unornamented, but at their lower ends irregularly spaced arched incrementals usually are visible; left valve sculptured with same number of ribs, but they are lower than on right valve, more rounded, and near ventral margin have sloping sides; interspaces wider than ribs; concentric lamellae in interspaces and incrementals on ribs more prominent than on the right valve; submargins on both valves smooth, except for very fine concentric lamellae; auricles subequal, the posterior one sculptured with 2 to 5 small radial ribs, decreasing in prominence from margin of disk or absent on dorsal part, entire surface covered with fine concentric lamellae; anterior auricle sculptured with 3 to 5 usually slightly coarser ribs of irregular width, slightly roughened by inconspicuous concentric lamellae; cardinal crura prominent; interior ventral margin deeply fluted.

A right valve: length 25.6 mm.; height 25.5 mm.; diameter 8 mm.; length of hinge 13 mm. A left valve: length 26.5 mm.; height 25.8 mm.; length of hinge 14 mm.

This species is the most abundant Bowden *Pecten*. The right valve is strongly inflated; the left valve is less inflated or even compressed, especially on young shells. The most inflated shells are less orbicular, as they are higher than wide. The difference in radial sculpture on

the two valves is striking. On the left valve, as the interspaces are wider than on the right, the concentric sculpture is more prominent and the arched, crowded growth-lines on the ribs are more uniform. Left valves are usually more inequilateral than right ones. The ribs of immature left valves are less rounded near the ventral margin than on adults; young right valves differ from adults in having lower ribs and wider interspaces.

C. inaequalis was described by Sowerby from the Dominican Republic, where it has since been collected from the Gurabo formation. It reaches a larger size than *C. uselmae;* left valves of *C. uselmae* are very similar to left valves of *C. inaequalis,* but the ribs of right valves of *C. uselmae* are higher, flatter, and have excavated flanks. *C. costaricensis* (Olsson),[1] a Miocene species from Costa Rica, is very similar, but is less inequilateral, and has lower ribs. Young shells of *C. uselmae* closely resembles *C. mayaguezensis,* a living species described by Dall and Simpson from Porto Rico, but the ribs of right valves of the Bowden species are lower and not so square.

Type material.—Holotype (right valve, Acad. Nat. Sci. Philadelphia, No. 11124).

Chlamys (Plagioctenium) concinnatus, new species.

(Plate 8, Figure 8.)

The following is a description of this species:

Shell medium-sized, slightly inequilateral; left valve moderately inflated, sculptured with 17 strong, almost flat-topped ribs, separated by interspaces of virtually same width as ribs; concentric sculpture consisting of fine, sharply raised lamellae, overriding ribs except on lower half of shell; lamellae arched in interspaces, with the convex side toward ventral margin; submargins sculptured with concentric lamellae, finer than those on disk; auricles subequal, radially and concentrically sculptured; cardinal crura prominent; right valve not known.

Left valve: length 14.5 mm.; height 14.7 mm.; diameter 2.6 mm.; length of hinge 7.5 mm. (estimated).

This species is known only from the holotype, a left valve. The strong, subrounded radial ribs and conspicuous concentric lamellae over the entire surface of the disk, except on the lower part of the ribs, distinguish it from other Bowden Plagioctenium.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352784).

Chlamys (Plagioctenium) ameleus, new species.

(Plate 8, Figure 9.)

The following is a description of this species:

Shell small, subequivalve, suborbicular, the two valves equally inflated; both valves sculptured with 21 to 23 strong, subrounded ribs, separated by narrower interspaces; concentric sculpture of fine lamellae usually appears

[1] Comparison based on figures.

in interspaces and occasionally on ribs, absent on submargins; auricles unequal, both bearing inconspicuous radials; on the posterior auricle the radials are more prominent ventrally, but on the anterior auricle they are broader and stronger dorsally, overridden by fine concentric lamellae, coarser and more irregular on the anterior auricle.

A right valve: length 15 mm.; height 14.8 mm.; diameter 3.2 mm.; length of hinge 8 mm. A left valve: length 13.5 mm.; height 13.2 mm.; diameter 3.5 mm.; length of hinge 6.2 mm.

Some shells are slightly less rounded than the holotype. On some shells a slight groove lies on the extreme lower part of a few ribs.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352785).

Chlamys (Plagioctenium) mansfieldi, new species.

(Plate 8, Figure 10.)

The following is a description of this species:

Left valve small, moderately inflated, suborbicular, subequilateral; radial sculpture consisting of 17 or 18 narrow, square ribs separated by deeply channeled interspaces slightly wider than ribs; concentric sculpture consisting of widely spaced lamellae overriding radials except on umbo; auricles subequal, sculptured with 4 or 5 radial ribs overridden by concentric lamellae; right valve not known.

Left valve: length 8 mm.; height 8 mm.; diameter 1.4 mm.; length of hinge 6 mm.

C. mansfieldi is represented by a few valves, probably none of which is full grown. It is less inflated than *C. ameleus* and has narrower and more rectangular ribs and more widely spaced concentric lamellae.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352786).

Chlamys (Plagioctenium) gonioides, new species.

(Plate 8, Figures 11, 12.)

Pecten (Aequipecten) oxygonum Dall (part, not Sowerby), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 713–714.

The following is a description of this species:

Shell small, subequivalve, suborbicular, posterior end slightly more extended and unevenly rounded; posterior dorsal margin longer than anterior; right valve sculptured with 22 or 23 subangular radial ribs, their summit slightly rounded, on adult shells the ribs are rounded at the ventral margin, ribs separated by subangular interspaces; on the slope of ribs and in bottom of interspaces are fine, closely spaced concentric lamellae, usually not rising above summits of ribs; left valve sculptured with 18 or 19 similar but broader and more sharply angular ribs and similar concentric lamellae; submargins of both valves smooth, except for fine, inconspicuous concentric lamellae; auricles subequal, sculptured with 4 or 5 narrow, unequally spaced radial ribs crossed by concentric lamellae; cardinal crura large.

A left valve: length 14 mm.; height 14.1 mm.; diameter 3.2 mm.; length of hinge 8.2 mm. A right valve: length 12.3 mm.; height 12.2 mm.; diameter 3 mm.; length of hinge 6 mm.

The two valves are almost equally inflated, but most left valves are slightly less inflated and more inequilateral. The radial sculpture on the two valves is quite different; on the left valve the ribs are fewer, broader, and more distinctly angular, though slightly rounded especially at the ventral margin and in the umbonal region. The concentric lamellae rarely override the ribs. Two large right valves, larger than the holotype, have ribs that are rounded and even flattened at the ventral margin. As usual, young shells are more rounded than adults.

C. gonioides closely resembles *C. oxygonum* described by Sowerby from the Dominican Republic. The U. S. Geological Survey expedition collected from the Cercado formation on Rio Mao (station 8521) a valve that agrees with Sowerby's description. The Bowden species has less angular ribs and interspaces, shallower interspaces, and weaker concentric sculpture.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352787); paratype (right valve, U. S. Nat. Mus. No. 353076).

Subgenus PALLIOLUM Monterosato.

Monterosato, 1884, Nomenclatura generica e specifica di alcune conchiglie Mediterranee, p. 5.

Type (by subsequent designation, Cossmann and Peyrot, 1912).—*Pecten testae* Bivona. Recent, Mediterranean Sea.

The following is a description of the subgenus *Palliolum*:

Shell small, thin, equivalve, slightly inflated; anterior auricles longer than posterior, right anterior auricle sculptured with coarser radial threads than left anterior auricle, and bearing a prominent byssal notch; ctenolium present; sculpture consisting of fine, slightly roughened vermicular markings bent upward at ends of shell; cardinal crura absent; interior of shell smooth.

The Bowden species described by Dall as *Pecten (Pseudamusium) guppyi* is difficult to place. It bears no resemblance to *Pecten hybridus* Gmelin, the type of *Pseudamusium* H. and A. Adams.[1] Pectens of this type are placed in *Cyclopecten* Verrill by some writers, although they are not similar to *Cyclopecten pustulosus* Verrill, the type species.[2] They are more similar to *Pecten testae,* the type of *Palliolum,* but have less unequal auricles, no ctenolium, and a conspicuously striated provinculum.

Chlamys (Palliolum?) guppyi (Dall).

(Plate 8, Figures 13 to 16.)

Pecten (Pseudamusium) guppyi Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 718, 755, plate 34, figs. 12, 13.

The following is the original description of this species:

[1] Type designated by Suter 1913. *Pecten exoticus* Chemnitz, which is said to be the same as *Pecten pseudamusium* Sowerby, is usually given as the type, but it is not in the original list of H. and A. Adams.

[2] Type designated by Suter, 1913.

Shell small, suborbicular, moderately convex, smooth, with the surface covered with microscopic Camptonectes striation; ears small, the anterior slightly larger, all with very minute radiation and concentric lines; notch narrow, small, with no ctenolium; interior smooth, without lirae or developed crura; traces of the auricular crura alone perceptible; cardinal margin bearing a sharply cross-striated, very distinct provinculum; basal margins flattened, posterior margin slightly compressed. Alt. 6, lat. 6 mm.

Type locality.—Bowden, Jamaica.

On the right valve the anterior auricle is larger than the posterior and is sculptured with relatively coarse radial threads crossed by fine concentric lamellae. On the left valve the auricles are subequal and sculptured with fine radial threads and concentric lamellae. Some right valves have an anterior and posterior radial thickening, resembling ribs, on the interior.

A similar species from the Cercado formation of the Dominican Republic is smaller, more inflated and less elongate dorso-ventrally. A fragmentary valve resembling *C. guppyi* was collected from the Gurabo formation of the Dominican Republic. *C. guppyi* closely resembles *C. aotus* (Olsson), a Miocene species from Costa Rica, but is larger and the auricles of the left valve have distinct sculpture.

Type material.—2 cotypes (U. S. Nat. Mus. No. 135779).

Genus AMUSIUM Bolten.

Subgenus AMUSIUM s. s.

Bolten, 1798, Museum Boltenianum, part 2, p. 165.

Type (by subsequent designation, Dall, 1886.)—Ostrea pleuronectes Linné. Recent, China Sea.

The following is a description of the subgenus *Amusium* s. s.:

Shell reaching a large size, thin, suborbicular, slightly inflated, right valve slightly more inflated than left; radial sculpture absent on exterior; auricles subequal; byssal notch very small, ctenolium absent; disk and auricles bearing very fine incrementals; chondrophore moderately large, shallow, flanked by 2 pairs of cardinal crura, lower much shorter and weaker than upper; interior sculptured with narrow paired ribs that fail to reach ventral margin of valve.

The smooth exterior and ribbed interior are characteristic features of *Amusium*. Its present distribution (West Indies, Pacific, and Indo-Pacific) is less extensive than its distribution during Tertiary time, when it lived in virtually all warm seas.

Amusium (Amusium) papyraceum (Gabb)?

(Plate 9, Figures 1, 2.)

Pleuronectia papyracea Gabb, 1873, Trans. Amer. Philos. Soc., new ser., vol. 15, p. 257.

Amusium papyraceum (Gabb), Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 718, 719. Maury, 1917, Bull. Amer Paleontology, vol. 5, p. 354, plate 26, fig. 22. Maury, 1920, Scientific

Survey of Porto Rico and the Virgin Islands, vol. 3, part 1, p. 21, N. Y. Acad. Sci. ? Hubbard, 1921, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 2, p. 96, N. Y. Acad. Sci. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 413, plate 43, figs. 8, 9.

The following is the original description of this species:

Shell discoidal, sub-circular, very slightly longer than wide; slightly inequivalve; ears nearly equal; surface perfectly smooth, or marked only by faint lines of growth; internal surface marked with small radiating ribs. Length from beak to base 2.2 inch, width 2 inches.

Type locality.—Dominican Republic.

The collections from Bowden contain small pieces of a large *Amusium* and 2 broken immature valves. The pieces show that the ventral part of the exterior is smooth, except for faint, closely spaced incrementals, and the interior is sculptured with paired ribs. These fragments are too imperfect for accurate identification, but are very similar to *A. papyraceum*. In the Dominican Republic *A. papyraceum* has been collected from both the Cercado and Gurabo formations. It has a somewhat ovate outline and polished exterior. The Miocene and Pliocene North American species *A. mortoni* Ravenel usually is larger and more orbicular. *A. luna* Brown and Pilsbry, described from the Gatun formation of the Canal Zone, has strongly depressed and smaller auricles.

Fragmentary valves from the San Sebastian shale (middle Oligocene) of Porto Rico, and other beds whose name and age are not given, are referred to this species by Maury and Hubbard.

Other localities.—Cercado (lower Miocene) and Gurabo (middle Miocene) formations, Dominican Republic.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia, No. 2864).

Subgenus PARVAMUSSIUM Sacco.

Sacco, 1897, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, part 24, p. 48.

Type (by original designation).—Pecten duodecim-lamellatus Bronn. Miocene and Pliocene, Italy.

The following is a description of the subgenus *Parvamussium*:

Shell small, thin, higher than wide, both valves moderately inflated; external sculpture of both valves consisting of fine concentric threads; auricles subequal; internal sculpture consisting of radial ribs that do not quite reach the ventral margin; chondrophore small, flanked by a pair of obscure cardinal crura.

The small, thin shell and unpaired internal ribs are characteristic features of *Parvamussium*. American Tertiary species usually have been referred to *Propeamusium* de Gregorio. *Pecten ceciliae* de Gregorio, the type species of *Propeamusium,* is much larger and has no internal ribs.

Amusium (Parvamussium) spendulum, new species.

(Plate 9, Figures 3, 4.)

The following is a description of this species:

Shell small, thin, compressed, suborbicular, higher than wide; dorsal margins sloping steeply; external surface of left valve sculptured with very fine concentric threads, disappearing toward ventral margin and replaced by a few faint, coarser, more widely spaced threads; dorsal half of shell bearing very fine radial striae, barely visible under the microscope; entire surface covered with camptonectes striations; internal ribs visible from exterior; auricles small, bearing a median broad ridge, separated from the disk by a slightly depressed groove; interior sculptured with 11 relatively heavy ribs, extending about half the distance to the umbo, thickened toward ventral margin, but terminating before margin is reached; upper extremities of ribs acute, except the two nearest the dorsal margin, which are rounded; right valve not known.

Length 5.8 mm.; width 6.1 mm.

This species is remarkably similar to *A.* (*P.*) *pourtalesianus* (Dall), one of the most common of the deeper water species in the Gulf and West Indian waters. The living species is larger, more orbicular, and has larger auricles, and less conspicuous external sculpture; the internal ribs are not quite so heavy, less swollen, and extend farther toward the umbo.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352788).

Family SPONDYLIDAE.

Genus SPONDYLUS Linné.

Linné, 1758, Systema Naturae, ed. 10, p. 690.

Type (*by subsequent designation, Gray, 1847*).—*Spondylus gaederopus* Linné. Recent, Mediterranean Sea.

The following is a description of the genus *Spondylus*:

Shell reaching a large size, trigonal-suborbicular; auricles small, subequal; right valve higher and more inflated than left; sculpture consisting of low radial ribs and foliaceous lamellae or spines; cardinal area wider on right valve than on left; chondrophore small, triangular, median; hinge of both valves consisting of 2 heavy crural teeth, representing laterals, and 2 sockets symmetrically placed with respect to chondrophore; right valve bearing along lower outer edge of cardinal area on both sides a rude horizontal lamella fitting into space between crural tooth and lower margin of cardinal area of left valve; muscular impression suborbicular, posterior.

Spondylus has a long geologic history. Its present distribution in the warm seas of the world is similar to its Tertiary distribution.

Key to the Bowden species of Spondylus.

Spine-bearing ribs widely spaced, spines short..... *S. bostrychites*
Spine-bearing ribs closely spaced, spines long..... *S.* species

Spondylus bostrychites Guppy.

(Plate 9, Figures 5 to 7.)

Spondylus bifrons Sowerby, 1849, Quar. Jour. Geol. Soc. London, vol. 6, p. 53. Not *S. bifrons* Goldfuss, 1835.

Spondylus bostrychites Guppy (part), 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 176. Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 87. Gabb, 1873, Trans. Am. Philos. Soc., n. s., p. 257. Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 443 (list). Dall (part), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 758-759. Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 354-355, plate 58, fig. 4. ? Maury, 1920, Sci. Survey Porto Rico and Virgin Islands, vol. 3, part 1, pp. 22-23, N. Y. Acad. Sci. ? Hubbard, 1921, Sci. Survey Porto Rico and Virgin Islands, vol. 3, part 2, p. 97, N. Y. Acad. Sci. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 413. Not Dall, 1915, U. S. Nat. Mus. Bull. 90, p. 124, plate 19, fig. 4. Not Cooke, 1919, Carnegie Inst. Wash. Pub. 291, p. 144, plate 11, figs. 11 *a, b*.

The following is the original description of this species:

Testa subregularis, rotondata, ventricosa, margine latiusulco, valide denticulato; extus radiatim costata, costa 5 ad 6 spiniferis; area cardinali alterius valvae angustissima, alterius latiori.

Type locality.—Dominican Republic.

The following is a description of Bowden specimens of this species:

Shell medium-sized, suborbicular, auricles moderately large; right valve much more inflated than left and bearing a much wider cardinal area; sculpture of right valve consisting of 8 to 10 low primary radial ribs from which short spines, which usually are broken, rise at irregular intervals; between primary ribs are 4 to 5 secondary ribs of irregular width; near the base the secondaries are almost or quite as high as primaries; all ribs and interspaces near base sculptured with looped concentric lamellae and fine scales arranged in linear radial series; left valve sculptured with lower and narrower ribs, the ribs and interspaces bearing radial rows of fine scales, like on right valve; cardinal area of right valve very wide, almost horizontal; cardinal area of left valve very narrow, virtually vertical.

Length 47 mm.; height 52 mm.; diameter (right valve) 15 mm.; length of hinge 27 mm.

The name *Spondylus bostrychites* has been applied to specimens from the Dominican Republic, Jamaica, Anguilla, Antigua, Porto Rico, and Florida, collected from beds of middle Oligocene to middle Miocene age. These specimens probably represent 2 or 3 species. The first step is to consider the type of *S. bostrychites*. The type of this species is the same as the type of *S. bifrons* Sowerby in the British Museum. The fossils that Sowerby described came from the Yaque Valley, Dominican Republic, and as virtually all the species have been discovered in the Gurabo formation, it can safely be assumed that the common *Spondylus* in the Gurabo formation is *S. bostrychites*. When Guppy renamed *S. bifrons* Sowerby he stated that the species is found in "Haiti" and Anguilla and 2 shells from Anguilla in the Guppy collection (U. S. Nat. Mus. No. 115523) are

labeled "types." But 2 shells from Bowden in the Guppy collection (U. S. Nat. Mus. No. 115522) also are labeled "types." Guppy's designation of these specimens in his collection as types has no bearing whatever on the actual type of *S. bostrychites*.

Specimens of *S. bostrychites* from the Gurabo formation are more than 100 mm. in length and height and have relatively wide and widely spaced primary ribs. Specimens from Bowden seem to represent this species, but there are no perfect large shells. A broken piece in the United States National Museum collection (No. 135773) is part of a large valve comparable in size to the Dominican valves. It has wider ribs and larger scales than specimens from the Gurabo formation. Plate 9, figures 5 and 6, represent a much smaller right valve having an abnormally thick umbo. These small shells from Bowden have slightly larger auricles than small shells from the Gurabo formation and the rows of scales are farther apart. Some left valves from the Gurabo formation are as inflated as right valves, but this feature is variable. Additional material may show that the Bowden *Spondylus* represents a different species, though in essential features it resembles *S. bostrychites*.

Shells from Anguilla and Antigua have more numerous and usually narrower ribs bearing spines. The valves that are in attached position seem to have a more symmetrical cardinal area, but this feature may be due to position during growth.

A right valve from the Tampa formation is more elongate and has many narrow ribs of uniform width. *S. chipolanus* Dall also has many narrow ribs bearing long spines.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—6 cotypes (Geol. Soc. London No. 12833), deposited in British Museum (Natural History), Geological Department.

Spondylus species.

(Plate 9, Figure 8.)

The following is a description of this species:

Shell small, higher than wide; valve sculptured with 11 or 12 ribs, bearing closely spaced spines that are very long for the size of the shell and slightly curved; on parts of the shell the spines are represented by irregularly curled lamellae extending across one or more ribs; between the primary ribs are poorly defined radial rows of small, irregularly spaced scales, interrupted by the transgression of the broad scales; auricles small, their surface roughened or bearing a few spines; inner surface of the valve irregularly fluted; left valve not known.

Length 10 mm.; height 11.8 mm.; diameter 3 mm.; length of hinge 5.5 mm.

This species is known only from a small right valve. It is remarkably similar to the living West Indian species *S. echinatus* (Martyn),

which has not been recorded from deposits older than Pleistocene. No Recent shells comparable in size are available for comparison. The spines of the shell that generally has been called *S. spathuliferus* are more compressed dorso-ventrally, and their ends are irregularly fluted, but apparently the spinose sculpture is variable, as is indicated by the elaborate synonomy given by Dall.

Genus PLICATULA Lamarck.

Lamarck, 1801, Systême des Animaux sans Vertèbres, p. 152

Type (by subsequent designation, Gray, 1847.)—Plicatula gibbosa Lamarck. Recent, West Indies.

The following is a description of the genus *Plicatula*:

Shell small, irregular in outline, attached by either valve; sculpture consisting of broad radial ribs that may divide near margin; cardinal area very small; chondrophore narrow, elongate, flanked on each side by a fluted crural tooth representing a lateral, and socket; impression of adductor muscle ovate, posterior; margin of valve fluted.

The present distribution of *Plicatula* in some of the warm seas (West Indies, Pacific and Indian Oceans) is more restricted than its Tertiary distribution.

Plicatula guppyi, new species.

(Plate 9, Figures 9 to 11.)

Plicatula vexillata Guppy (part), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pp. 86-87 (not plate 2, fig. 7, = *P. gibbosa* Lamarck). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 436 (not plate 17, fig. 7, = *P. gibbosa* Lamarck).

Plicatula densata Dall (part, not Conrad), 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 763.

The following is a description of this species:

Shell small, subequilateral or very inequilaterial, moderately or slightly inflated, outline irregular, usually more or less rounded-triangular or subovate; umbos low; sculpture consisting of 5 to 9 strong ribs, most prominent at ventral margin and not extending to umbo; concentric sculpture consisting of irregular, more or less overlapping lamellae, stronger on the ribs and in some shells producing short, broad scales on the ribs; inner margin of valve coarsely fluted by the ribs and usually finely corrugated; inner surface of valve irregular.

Right valve: length 12 mm.; height 15.5 mm.; diameter 2.8 mm.

The type material of *P. vexillata* consists of 2 cotypes. One, an entire shell, was the specimen figured and described by Guppy. It seems to be a small *P. gibbosa* Lamarck, as it has the color markings and other features, as Dall has shown. It does not have the yellowish-brown color of shells from Bowden and probably is a Quaternary shell mixed in Guppy's collection with Bowden shells. The other specimen, which has the appearance of a Bowden shell, is a smaller right valve. It is the holotype of *P. guppyi*. Other specimens of *P. guppyi* are in all collections examined.

P. guppyi is smaller than *P. gibbosa,* and has more distinctly foliaceous ribs. It also is smaller than *P. densata* Conrad, an American Miocene species, and has more distinctly foliaceous ribs and no secondary marginal ribs. Probably the same species has been recorded by Olsson from Miocene beds in Panama and Costa Rica under the name of *Plicatula marginata* Say.[1] All specimens from Bowden, and apparently those from Panama and Costa Rica, are smaller than *P. marginata,* an American upper Miocene and Pliocene species, and consequently have narrower and lower ribs.

Type material.—Holotype (a right valve in the Guppy collection, 1 of the 2 cotypes of *P. vexillata,* U. S. Nat. Mus. No. 115536).

Family LIMIDAE.

Genus LIMA Cuvier.

Subgenus LIMA s. s.

Section LIMA s. s.

Cuvier, 1798, Tableau Elémentaire de l'Histoire Naturelle des Animaux, p. 421.

Type (by monotypy).—Ostrea lima Linné. Recent, Indo-Pacific.

The following is a description of the section *Lima* s. s.:

Shell medium-sized, moderately inflated, obliquely inequilateral, anterior submargin flattened; anterior and posterior ends narrowly gaping; auricles unequal, the posterior larger; sculpture consisting of scaly ribs; cardinal area wide, triangular, chondrophore large, central; hinge edentulous; adductor scar high, posterior; margin of valve fluted.

The Tertiary and present distribution of *Lima* is almost cosmopolitan.

Lima (Lima) stenacostata, new species.

(Plate 9, Figures 12, 13.)

The following is a description of this species:

Shell small, thin, moderately inflated, very inequilateral and oblique; sculpture consisting of 24 low narrow ribs, separated by broader interspaces; the ribs are widest and most prominent in the umbonal region, toward the ventral margin they become higher and may have short narrow scales at irregular intervals, or are roughened by irregular incremental lamellae on the lower third of the shell; anterior submargin wide, long, deeply depressed; posterior submargin much smaller and less deeply depressed; auricles small, subequal, not differentiated from submargins; both auricles and submargins sculptured with irregular concentric lamellae and indistinct radials; cardinal area wide; ligament pit large, deep, subumbonal and vertical, extending into cavity of shell; ventral margin of valve scarcely affected by ribs.

Length 10.5 mm.; height 12 mm.; diameter (left valve) 2.8 mm.; length of hinge 5 mm.

The preceding description is based on the holotype, a left valve, which is the only specimen. The radial sculpture is weaker than in

[1] Comparison based on figures.

most species of the section *Lima* s. s. The posterior submargin is unusually long and so deeply depressed that it has a decided effect on the outline of the shell. *L. tampaënsis* Dall, described from the Chipola formation of Hillsborough Bay, Florida, is larger and has stronger radials and a fluted base.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352792).

Section MANTELLUM Bolten.

Bolten, 1798, Museum Boltenianum, part 2, p. 160.

Type (by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1888).—Ostrea inflata Gmelin. Recent. Mediterranean Sea.

The following is a description of the section *Mantellum*:

Shell medium-sized, thin; strongly inflated, obliquely inequilateral, posterior and anterior ends widely gaping; auricles small, subequal; sculpture consisting of narrow radial ribs, roughened by incrementals; cardinal area narrow; chondrophore very large; part of shell under cardinal area excavated on posterior side; hinge edentulous; ventral margin of valve weakly fluted.

The greater inflation, wider gape, absence of flattened anterior submargin, and weak sculpture separate *Mantellum* from *Lima* s. s. *Ostrea hians* Gmelin, a species that is not in Bolten's original list, usually is cited as the type of *Mantellum*.

The Tertiary and living species of *Mantellum* have a wide distribution.

Lima (Mantellum) species.

(Plate 9, Figures 14, 15.)

The following is a description of this species:

Shell small, fragile, obliquely elongate, dorsal margins short, straight, the anterior longer; posterior end rounded above, slightly insinuated at dorsal margin of gape, obliquely truncated below; anterior margin subparallel to posterior truncation; base rounded; sculpture consisting of a few barely visible narrow ribs near the ventral margin, extending almost half the length of shell in posterior-ventral region; concentric sculpture limited to a few weak, fine lamellae on ventral half of shell; entire surface covered with microscopic vermicular markings, most prominent on umbo; cardinal area narrow; chondrophore wide, shallow, not projecting into cavity of shell; interior of valve bearing faint radial markings in posterior-ventral region.

Median length (measured along a line perpendicular to the oblique axis) 5 mm.; height 7 mm.; diameter (right valve) 1.8 mm.; length of hinge 1.5 mm.

The very oblique outline and almost smooth surface of this species, which is represented by a broken right valve, are characteristic features.

Genus LIMEA Bronn.

Bronn, 1831, Italiens Tertiär-Gebilde und deren organische Einschlüsse, p. 115.

Type (by monotypy).—Ostrea strigilata Brocchi. Miocene and Pliocene, Italy.

The following is a description of the genus *Limea:*

Shell very small, obliquely subovate, strongly inflated; auricles small, subequal; sculpture consisting of minutely beaded radial ribs; cardinal area narrow; chondrophore small, triangular, subumbonal; hinge consisting of a series of taxodont denticulations on both sides of chondrophore; margin of valve fluted.

This little genus has an unusual geologic history. In Europe it is recorded from deposits of Jurassic age. One of these European species, *L. duplicata* Sowerby, has been described from Jurassic beds in east Greenland, but there are no other American Mesozoic species. No fossil species are known from the American mainland north of Central America. The Bowden species here described is the only American Tertiary species. It has recently been discovered in Miocene beds in Costa Rica and the Domincan Republic. The few living species are confined to the seas of Europe, the Atlantic Ocean, and the West Indies.

Limea solida Dall.

(Plate 10, Figures 1, 2.)

Limea solida Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 769, plate 35, figs. 4, 5. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 381, plate 31, fig. 10.

The following is the original description of this species:

Shell minute, solid, rounded triangular, with about 12 rounded, strong, slightly granular radial ribs, separated by narrower interspaces crossed by lines of growth; submargins without radial sculpture; hinge-line short, with a small central pit, on each side of which are about 8 teeth; interior radially feebly grooved, the basal margin crenulated by the ribs; shell moderately inflated. Alt. 3.5, lat. 3.3, diam. 2.5 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, subovate-trigonal, strongly inflated in umbonal region, subequilateral; curve of the lower part of posterior margin slightly more convex than corresponding part of anterior margin; base gently arcuate; umbos prominent; sculpture consisting of 14 to 16 strong radial ribs that are rounded on immature shells, but on adults are angular on the lower third of their length and bear minute beads on their sides; ribs separated by interspaces of virtually the same width; each interspace bearing a small, median, rounded, minutely beaded ridge; submargins sculptured with 10 to 15 concentric rugae, the posterior submargin longer and usually having more prominent and more numerous rugae; chondrophore small, shallow, subumbonal, flanked by 6 to 8 teeth on either side; inner margin of part

of shell that has radial sculpture deeply fluted; interior of shell bearing inconspicuous radial undulations corresponding to external radial sculpture.

Length 3 mm.; height 3.2 mm.; diameter (left valve) 0.9 mm.

One of the valves shows traces of dark coloration. Two valves of apparently the same species, though slightly smaller than the largest Bowden shells, were collected from the Gurabo formation in the Dominican Republic at station 8544 on Rio Gurabo. Olsson records a small specimen having only 12 ribs from Costa Rica.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (left valve) (U. S. Nat. Mus. No. 135679).

Superfamily ANOMIACEA.

Family ANOMIIDAE.

Genus PLACUNANOMIA Broderip.

Broderip, in Broderip and Sowerby, 1832, Proceedings Zoological Society of London, part 2, p. 28.

Type (*by monotypy*).—*Placunanomia cumingii* Broderip. Recent, Pacific coast of Central America.

The following is a description of the genus *Placunanomia:*

Shell large, suborbicular, irregularly warped; surface smooth or weakly sculptured; umbo of right valve bearing closed byssal opening; right valve bearing 2 strong cardinal crura that diverge at an acute angle and fit into a wide triangular depression on the left valve; outer edge of crura fitting into crude sockets along edge of triangular depression; margin of valve roughened on both sides of crura; adductor scar submedian, byssal scar lying obliquely above it and smaller.

Placunanomia is restricted to the Pacific Ocean, but is one of many genera that formerly lived in Atlantic waters, where it was represented by *P. plicata* Tuomey and Holmes, from the Duplin marl of the Carolinas, and *P. lithobleta* Dall, a middle Miocene West Indian and Central American species. According to Tuomey and Holmes, a living *P. plicata* was obtained from Charleston Harbor, but this record is discredited by Dall.

Placunanomia lithobleta Dall.

(Plate 10, Figures 3 to 5.)

Placunanomia lithobleta Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 778-779. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 356, plate 60, figs. 1, 2. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 382, plate 24, figs. 3 to 5.

The following is the original description of this species:

Shell resembling *P. plicata* [Tuomey and Holmes], but flatter; not plicate, but gently waved distally; surface radially sculptured with minute, almost microscopic, threads, which are frequently interrupted, when the termination of the proximal part of the thread is swollen, resem-

bling a minute head or pustule; interior resembling *P. plicata,* but the hinge weaker, the amorphous irregularities confined to a very small space near the umbo, and inconspicuous; crura of the lower valve small, forming an acute angle, well elevated, the socket for their reception on the opposite valve shallow. Alt. about 50, lat. 50, diam. about 8 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell large, compressed, irregularly suborbicular; irregularly warped and folded, the broad undulations most pronounced at the ventral margin, but not definitely plicate; umbonal region of some shells swollen; sculpture consisting of fine, discontinuous swollen radial threads, broken up into longer or shorter parts, or interrupted so frequently that they produce a finely pustulose appearance; byssal plug on right valve elongate, triangular, extending almost to cardinal margin; internal cardinal "rugosities" obscure or absent; right valve bearing strong cardinal crura, diverging at an acute angle; left valve bearing a large triangular umbonal depression into which the crura of the right valve are received, the anterior and posterior outer part of the depression separated by a triangular elevated area corresponding to the depressed area between the crura on the right valve.

All the valves of this species are more or less broken. The largest is about 48 mm. in length and height. The radial sculpture is irregular. Some parts of the shell, especially the umbonal region, may be smooth, or the fine, swollen radial threads may cover the entire surface. On one left valve the radials are well developed. Another left valve, of which only the dorsal half is preserved, has only very faint concentric markings and the triangular hinge depression does not have a median lower raised area.

As stated in the original description, *P. lithobleta* may be recognized by its radial sculpture. *P. plicata* Tuomey and Holmes is a smooth, marginally plicate species confined to the Duplin marl of the Carolinas. Maury has recorded *P. lithobleta* from an unknown Miocene horizon in the Dominican Republic, and Olsson has recorded it from Miocene beds in Costa Rica.

Other localities.—Middle (?) Miocene, Dominican Republic. Gatun formation (middle Miocene), Costa Rica.

Type material.—2 cotypes (U. S. Nat. Mus. No. 135778).

Genus ANOMIA Linné.

Linné, 1758, Systema Naturae, ed. 10, p. 700.

Type (by subsequent description, Gray 1847).—Anomia ephippium Linné. Recent, seas of Europe.

The following is a description of the genus *Anomia:*

Shell medium-sized, thin, irregular in outline, attached by left valve, which is more convex than right; exterior smooth, or more or less lamellar; resilium attached to umbonal cavity of left valve and to dorsal margin of right; interior of left valve bearing a subcentral group of 3 muscle-scars, the upper scar, which is the scar of the upper byssal muscle, the largest, the

other 2 scars lower, the anterior one being the lower byssal scar, the posterior one the adductor scar; right valve perforated by the byssal foramen, the interior bearing only the adductor scar.

The Tertiary and present distribution of *Anomia* is cosmopolitan.

Anomia indecisa Dall.

(Plate 10, Figures 6 to 9.)

Anomia simplex Guppy and Dall (not d'Orbigny), 1896, U. S. Nat. Mus. Proc., vol. 19, p. 326. Maury (not d'Orbigny), 1917, Bull. Amer. Paleontology, vol. 5, p. 355, plate 26, fig. 15.

Anomia microgrammata var. *indecisa* (Guppy Mss.) Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 783.

The following is a description of this species:

Shell small, thin, suborbicular; left valve moderately inflated, right valve flat; external surface smooth, or bearing very fine obscure radial threads near the ventral margin; upper byssal scar on left valve large, lower byssal scar and adductor scar very small, far below the upper byssal scar, placed on a slightly oblique line.

Left valve: length 19 mm.; height 18.5 mm.; diameter 5 mm.

Type locality.—Bowden, Jamaica.

A. indecisa resembles *A. microgrammata* Dall, which is confined to the Chipola formation of Florida, but the sculpture is more obscure and the lower byssal and adductor scars are much smaller and farther from the upper byssal scar. Externally the Bowden species more closely resembles the living West Indian *A. simplex* d'Orbigny, but the lower byssal and adductor scars are smaller, farther from the upper byssal scar, and more nearly in the same horizontal plane.

Specimens from the Cercado formation in the Dominican Republic have the same kind of muscle-scars, but the umbo of the left valve is more inflated. Fragments of probably the same species were collected from the Gurabo formation. The Miocene species recorded by Olsson from Panama and Costa Rica is larger, but its muscle-scars have not been described.

All the cotypes of *A. indecisa* have glue on some of the muscle-scars.

Other localities.—Cercado formation (lower Miocene), Dominican Republic. (?) Gurabo formation (middle Miocene), Dominican Republic.

Type Material.—4 cotypes (U. S. Nat. Mus. No. 107107).

Superfamily MYTILACEA.

Family MYTILIDAE.

Genus MODIOLUS Lamarck.

Section MODIOLUS s. s.

Lamarck, 1799, Mémoires de la Société d'Histoire Naturelle de Paris, pp. 87, 88.

Type (by monotypy).—Mytilus modiolus Linné. Recent, seas of Europe.

The following is a description of the section *Modiolus* s. s.

Shell medium-sized, moderately inflated, transversely elongate; umbos not terminal; external surface smooth except for incrementals; ligament subinternal; hinge edentulous; anterior adductor scar near umbo, posterior scar large.

Modiolus s. s. is not represented in the fauna of the Bowden formation.

Section BRACHYDONTES Swainson.

Swainson, 1840, A Treatise on Malacology, p. 384.

Type (by monotypy).—*Modiola sulcata* Lamarck. Recent, Indian Ocean.

The following is a description of the section *Brachydontes*:

Shell resembling *Modiolus* s. s. in outline; sculpture consisting of narrow radial ribs; cardinal border slightly corrugated; ventral and posterior margin of valve finely corrugated.

The Tertiary and living species of *Brachydontes* are most abundant in tropical waters. During Tertiary time they were more widely distributed than at the present time.

Modiolus (Brachydontes) guppyi Dall.

(Plate 10, Figures 10 to 12.)

Modiolus (*Brachydontes*) *guppyi* Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 794, plate 35, fig. 16.

The following is the original description of this species:

Shell small, thin, delicate, radially numerously ribbed, the ribs but seldom dichotomous, general form as in *M. grammatus* [Dall], but shorter and more rounded, the surface frequently concentrically faintly undulated, inner dorsal margin sharply crenulate, the rest of the shell margin almost smooth, basal end of the valve rounded, dorsal angle obsolete. Alt. 8.5, max. lat., 4.7, diam., 2.5 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, thin, transversely elongate, widest at about middle of shell; umbos inflated, almost terminal; umbonal ridge strong, rounded, becoming lower and broader toward posterior end; inner third or more of dorsal margin straight, forming a subrounded angle of about 140° with the outer part, which is gently curved or slightly emarginate; ventral margin usually slightly concave; posterior margin narrow, abruptly rounded; sculpture consisting of numerous inconspicuous rounded ribs, separated by interspaces of the same width or narrower; ribs usually absent on the most convex part of the umbonal ridge; concentric sculpture consisting of usually faint incremental threads, occasionally exaggerated; hinge bearing 2 or 3 projections on left valve and obscure sockets on right; inner part of inner dorsal margin conspicuously corrugated, the outer part weakly corrugated, remainder of the margin usually smooth or faintly corrugated.

Length 10.5 mm.; height 5.5 mm.; diameter 1.8 mm.

The height varies, the measured valve being the highest. All the shells have a rudimentary hinge. One of the left valves has 3 small distinct projections, and most of the others have suggestions of 2 or 3 similar projections. Right valves have corresponding obscure depressions.

The differences between this species and *M. grammatus* Dall, described from the Tampa formation of Florida, are given by Dall in the original description. The living West Indian species *M. citrinus* Bolten is larger, wider, more rounded anteriorly, and its entire inner margin is corrugated.

Type material.—2 cotypes (U. S. Nat. Mus. No. 135747).

Family DREISSENIDAE.

Genus MYTILOPSIS Conrad.

Conrad, 1857, Proceedings Academy of Natural Sciences of Philadelphia, p. 167.

Type (by monotypy).—Mytilus leucophyaetus Conrad. Recent, southeastern United States.

The following is a description of the genus *Mytilopsis:*

Shell small, strongly inflated, mytiloid, slightly gaping along anterior part of ventral margin; surface smooth, except for incrementals; ligament subinternal; hinge edentulous; anterior adductor seated on a short septum that roofs over the umbonal cavity, the septum prolonged downward on the dorsal side into a short pointed apophysis, extending toward the umbonal cavity; byssal muscle attached to apophysis; posterior adductor scar long, bilobed.

Mytilopsis has been confused with the genus *Congeria* Partsch. The type of *Congeria, C. subglobosa* Partsch, has a large, heavy subquadrate shell that has strongly incurved umbos. The attachment of the anterior adductor and byssal muscles is similar in the two genera, but the septum of *Congeria* is much heavier and wider and the apophysis is not directed downward into the umbonal cavity. The posterior adductor scar of *Congeria* has the outline of the figure 6.

In general features, *Mytilopsis* resembles *Dreissena* Vanbeneden (type, *Mytilus polymorphus* Pallas) more closely than *Congeria,* but the septum of *Dreissena* is simple and lacks the apophysis. *Mytilopsis* seems to be the American representative of *Congeria.*

Mytilopsis jamaicensis, new species.

(Plate 10, Figures 13, 14.)

The following is a description of this species:

Shell small, thin, strongly inflated, mytiloid, slightly gaping along ventral margin near anterior end; dorsal margin subangular or abruptly convex; umbonal ridge rounded, lying close to ventral margin; sculpture limited to irregularly spaced, occasionally exaggerated incrementals; septum short, shallow; apophysis rounded, projecting far into umbonal cavity.

Length 18 mm.; height 9.5 mm.; diameter (left valve) 3 mm.

M. jamaicensis closely resembles the common *Mytilopsis* from Colon that is known as *M. cocheata* (Kickx), but the septum of the Bowden species is narrower; the apophysis more rounded; and the area of attachment of the byssal muscle smaller. *M. rossmassleri* (Dunker), a living West Indian species, has a longer septum and more pointed apophysis. The outline of all these species is similar. Authentic specimens of *M. domingensis* (Recluz), which was described from the island of Haiti, are not available for comparison. Maury has reported *M. domingensis* from the Cercado formation of the Dominican Republic. The Bowden species has a narrower and shallower septum than *M. lamellata* (Dall), described from the Pliocene Caloosahatchee marl of Florida, and the shell is not so high.

Type material.—Holotype (left valve) (U. S. Nat. Mus. No. 352795).

Family JULIIDAE.

Genus JULIA Gould.

Gould, 1862, Proceedings Boston Society of Natural History, vol. 8, p. 284.

Type (by monotypy).—Julia exquisita Gould. Recent, Hawaiian Islands.

The following is a description of the genus *Julia*:

Shell small, moderately inflated, subquadrate; umbos terminal, prosogyrate; lunule small, deeply depressed, indenting margin of shell; margin of shell projecting outward below lunule; sculpture limited to incrementals; ligament subinternal; hinge edentulous; edge of lunule of right valve thickened and fitting behind a similar thickening on left valve; anterior adductor scar small, orbicular, subcentral.

This curious genus has an interesting present and past distribution. At the present time it is confined to the Hawaiian Islands and the island of Bourbon or Reunion east of Madagascar. Only 4 fossil species, all of Miocene age, have been described. As they occur in southeastern United States and in southern France, the genus had a more extensive Miocene distribution. *Julia floridana* Dall, the only American species heretofore described, is confined to the Chipola formation of Florida. The following 3 European species have been described: *J. girondica* (Benoist), from the Aquitanian of Aquitaine; *J. douvillei* Cossmann and Peyrot, from beds probably of Helvetian age in Aquitaine; *J. lecointreae* Dollfus and Dautzenberg, from the Helvetian of Touraine. An undescribed species was collected by the U. S. Geological Survey expedition from the Cercado and Gurabo formations of the Dominican Republic.

Julia gardnerae, new species.

(Plate 10, Figures 15, 16.)

The following is a description of this species:

Shell small, subquadrate, moderately inflated; dorsal margin arcuate; posterior margin rounded; base sloping toward posterior end; umbo prominent, placed at anterior end, strongly bent downward over the narrow deeply impressed lunule, margin below lunule sloping downward to the prominently extended anterior-ventral angle; at the anterior end a subrounded ridge curves from the umbo to the extended angle; inner edge of lunule of right valve flattened and extended, margin below lunule extended outward by the thickened ventral edge of the lunule; inner edge of lunule of left valve thickened; muscle-scar obscure.

Length 8 mm.; height 6.5 mm.; diameter (left valve) 2.2 mm.

This species is described from a number of valves, of which 2 are adult. It resembles *J. floridana* Dall, but is larger, heavier, more elongate, and has fuller umbos, deeper lunule, and the inner edge of the lunule is more heavily thickened. The undescribed species from the Dominican Republic is as large as *J. gardnerae,* but in general features closely resembles *J. floridana.* All these American species are larger than the type of the genus, but none has the inner edge of the lunule so heavily thickened and extending so far toward the interior of the shell. *J. gardnerae* resembles *J. douvillei* more closely than the other European species.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352796).

Superfamily POROMYACEA.

Family POROMYACIDAE.

Genus POROMYA Forbes.

Forbes, 1844, Report British Association for Advancement of Science for 1843, p. 143.

Type (by monotypy).—Poromya anatinoides Forbes (= *Corbula granulata* Nyst and Westendorp). Tertiary and Recent, Mediterranean Sea.

The following is a description of the genus *Poromya:*

Shell small, ovate, subequilateral; umbos full, central, prosogyrate; sculpture consisting of fine granules arranged in radial series; hinge of right valve consisting of a strong subumbonal cardinal tooth in front of a wide chondrophore; hinge of left valve consisting of a small cardinal tooth behind and above the chondrophore.

There are only a few Tertiary and living species of *Poromya.* The living species, some of which are deep-water dwellers, have a restricted distribution around the borders of the Atlantic and Pacific.

Poromya jamaicensis Dall.

(Plate 10, Figures 17 to 19.)

Poromya jamaicensis Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1509, plate 56, fig. 23.

The following is the original description of this species:

Shell small; hinge, interior and surface sculpture like those of *P. granulata* Nyst [and Westendorp] but differing from it by the absence of rostration at the posterior end, which is evenly rounded though more attenuated than the anterior end. Length 5.5, height 4.7, diameter 3.0 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, subequilateral, posterior end more extended, compressed toward posterior end; posterior part of base slightly emarginate on valves that have a decided posterior extension; area in front of umbo slightly excavated; sculpture consisting of conspicuous granules, obscurely arranged in radial series, the granules finer toward posterior end; ligament area opisthodetic, narrow, flattened, extending along entire posterior dorsal margin, poorly defined on left valve; chondrophore conspicuous, placed behind umbo, directed toward posterior end, almost external on left valve; hinge of right valve consisting of a heavy cardinal in front of the chondrophore; hinge of left valve consisting of an obscure cardinal between the chondrophore and socket for right cardinal; anterior dorsal margins bent upward near umbo, left posterior dorsal margin extended; interior subnacreous.

Length 7.5 mm.; height 6.5 mm.; diameter (left valve) 2.5 mm.

The posterior end of some valves is slightly extended and rounded; on others it is more extended and obscurely truncate. Most valves that have a rounded posterior end are right valves, and they have lower and broader umbos. The granules may be arranged along radial lines, but this arrangement is obscure or even absent on some shells. The living West Indian species that is called *P. granulata* is larger, more elongate and has finer granules.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135690).

Family CUSPIDARIIDAE.

Genus CUSPIDARIA Nardo.

Subgenus CUSPIDARIA s. s.

Nardo, 1840, Revue Zoologique, par la Société Cuvierienne, Année 1840, p. 30.

Type (by monotypy).—Tellina cuspidata Olivi. Recent, Mediterranean Sea.

The following is a description of the subgenus *Cuspidaria* s. s.:

Shell medium-sized, rostrate, left valve a little larger and more inflated than right; umbos inflated, prosogyrate; sculpture consisting of exaggerated incrementals; both valves bear a long, narrow, obliquely curved chondrophore; right valve bearing a long, wide upturned posterior lateral; pallial sinus shallow, wide.

Cuspidaria s. s. is represented in most of the present seas. Some of the species live in deep water. There are no species in the Bowden formation.

Subgenus CARDIOMYA A. Adams.

A. Adams, 1864, Annals and Magazine of Natural History, ser. 3, vol. 13, p. 330.

Type (by monotypy).—Neaera gouldiana Hinds. Recent, seas of Japan.[1]

According to Dall, *Cardiomya* resembles *Cuspidaria* s. s., but has radial sculpture, and a more vertical and prominent chondrophore.

The present distribution of *Cardiomya* is less extensive than its Tertiary distribution.

Cuspidaria (Cardiomya) craspedonia Dall.

(Plate 10, Figures 20 to 22.)

? Neaera costellata Guppy (not Deshayes), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 575 (name only). Guppy (not Deshayes), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p, 85 (name only).

Cuspidaria (Cardiomya) craspedonia Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1506, plate 57, fig. 17.

The following is the original description of this species:

Shell small, plump, rostrate, the disk sculptured with numerous elevated, simple, radial threads, with, in the interspaces, from 1 to 3 much finer subequal threads, the whole crossed by fine concentric lines of growth; the major radials increase somewhat in prominence near the posterior end; beaks low, submedian, inconspicuous; rostrum small, short, slightly recurved, subtruncate terminally, sculptured concentrically with a single feeble thread extending from the beaks to the lower posterior extremity; hinge normal, fossette very small; interior basal margin fringed by small projections corresponding to the major radial sculpture. Length 4.0, height 2.5, diam. 2.0 mm.

Type locality.—Bowden, Jamaica.

The chondrophore is small and almost vertical. The left anterior dorsal margin is extended and slightly bent upward.

C. craspedonia is smaller than *C. islahispaniolae* Maury, which was described from the Cercado formation of the Dominican Republic, and has stronger and less numerous radial threads. It also resembles *C. ornatior* Pilsbry and Johnson, one of Gabb's species from an unknown horizon in the Dominican Republic, but has a shorter posterior snout, and narrower and higher ribs.

Type material.—3 cotypes (U. S. Nat. Mus. No. 135691).

Subgenus BOWDENIA Dall.

Dall, 1903, Transactions Wagner Free Institute of Science of Philadelphia, vol. 3, part 6, p. 1504.

Type (by original designation).—Cuspidaria (Bowdenia) distira Dall. Miocene, Jamaica.

The following is a description of the subgenus *Bowdenia:*

Shell small, rostrate; umbos strongly inflated, prosogyrate; sculpture consisting of fine radial threads; hinge of right valve consisting of a prominent

[1] I have not seen the type species.

posterior cardinal tooth behind the small shallow chondrophore, margin of valve behind chondrophore slightly thickened; dorsal margin of right valve grooved near posterior end; hinge of left valve consisting of an obscure posterior lateral behind the subumbonal chondrophore; dorsal margin of left valve abruptly arched behind chondrophore to receive right posterior cardinal.

Bowdenia resembles *Cardiomya* in external features, but has a different hinge. The type is the only known species.

Cuspidaria (Bowdenia) distira Dall.

(Plate 11, Figures 1 to 5.)

Cuspidaria (*Bowdenia*) *distira* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1506, plate 57, fig. 16.

The following is the original description of this species:

Shell small, plump, with elevated beaks nearly centrally situated, attenuated, rostrate, and compressed behind; sculptured with 2 strong threads, one on the anterior dorsal slope and the other near the posterior border of the disk, which by its projection angulates the basal margin; between these two the surface is finely, radially striate, and a few nearly obsolete striations occur behind the posterior thread; rostrum compressed, straight or a little decurved, nearly smooth, a few faint radial striae on its basal aspect, rounded terminally; hinge as described in the diagnosis of the subgenus; basal margin entire except where the radial thread forms a small projection. Length 3, height 2, diameter 2 mm.

Type locality.—Bowden, Jamaica.

This small *Cuspidaria* seems to be unlike any other described species.

Type material.—3 cotypes (U. S. Nat. Mus. No. 135692).

Family VERTICORDIIDAE.

Genus VERTICORDIA J. Sowerby.

Subgenus VERTICORDIA s. s.

J. Sowerby, 1844, Mineral Conchology of Great Britain, vol. 7, plate 639.

Type (*by monotypy*).—*Verticordia cardiiformis* J. Sowerby. Pliocene, England.

The following is a description of the subgenus *Verticordia* s. s.:

Shell small, cardiform, nacreous; umbos strongly prosogyrate; lunule deeply depressed; sculpture consisting of high, narrow radial ribs roughened by concentric beads; ligament internal; right valve bearing a heavy subumbonal tooth; inner edge of lunule on left valve thickened; ventral margin of valve deeply fluted.

Verticordia s. s. is represented by living species in many parts of the world. The oldest species are of Eocene age. There are no Bowden species.

Subgenus TRIGONULINA d'Orbigny.

d'Orbigny, 1853, in de la Sagra, Histoire Physique, Politique et Naturelle de l' Ile de Cuba; Mollusques, voi. 2, p. 291. (Spanish edition 1845?).

Type (by monotypy).—Trigonulina ornata d'Orbigny. Recent, West Indies.

The following is a description of the subgenus *Trigonulina:*

Shell small, cardiform, nacreous, strongly inflated; umbos flattened, strongly prosogyrate; lunule very deeply depressed; sculpture consisting of a few high, narrow radial ribs, interspaces at the posterior end of shell very wide; ligament internal; ligament groove long and deep on right valve; hinge like in *Verticordia* s. s.

Verticordia s. s. and *Trigonulina* are very similar. They differ in sculpture and *Trigonulina* has a more deeply depressed lunule and deeper ligament groove. Trigonulinas are characteristic of the West Indies and nearby regions. Species of Eocene, Oligocene, and Miocene age have been described from the Gulf states.

Verticordia (Trigonulina) bowdenensis Dall.

(Plate 11, Figures 6 to 8.)

Verticordia (Trigonulina) bowdenensis Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1512.

The following is the original description of this species:

Shell small, rotund, rather convex, with 8 or 9 anterior radial ribs with deep, subequal interspaces, then a wide space followed by 2 adjacent ribs, then a much wider space with another adjacent pair beyond it separated by a smooth area, larger in the left than in the right valve, from the posterior margin; the surface when intact is covered with minute granules arranged in rows harmonizing with the ribs; lunule very deeply impressed in the left valve, less so in the right; tooth of the right valve large and strong, the posterior margin of the left valve modified to form a lamina or lateral tooth received in a groove of the opposite valves. Lon. 2.7, alt. 2.6, diam. 2.0 mm.

Type locality.—Bowden, Jamaica.

The largest valve has the following dimensions: length 3.5 mm.; height 3.5 mm.; diameter (right valve) 1.5 mm. Dall has noted that this species was labeled "*V. ornata* d'Orbigny," the type of the subgenus, in the Guppy collection. The Bowden species has more numerous and narrower ribs and narrower interspaces, but the interspace at the posterior end of the shell is relatively wider.

Type material.—3 cotypes (U. S. Nat. Mus. No. 135689).

Subgenus HALIRIS Dall.

Dall, 1866, Bulletin Museum of Comparative Zoology at Harvard College, vol. 12, p. 287.

Type (by original designation).—Verticordia fischeriana Dall. Recent, Gulf of Mexico.

The following is a description of the subgenus *Haliris:*

Shell small, cardiform, nacreous, strongly inflated; umbos full, strongly prosogyrate; lunule moderately depressed; sculpture consisting of narrow radial ribs, ribs and interspaces granulated; hinge of left valve consisting of an obscure subumbonal cardinal; hinge of right valve consisting of a large subumbonal cardinal fitting in front of left cardinal; ventral margin of valve fluted.

The hinge and sculpture of *Haliris* are its most conspicuous features. *Haliris* is an American group of Verticordias dating back to Eocene time.

Verticordia (Haliris) jamaicensis Dall.

(Plate 11, Figures 9 to 11.)

Verticordia (Haliris) jamaicensis Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1511.

The following is the original description of this species:

Shell small, thin, subquadrate, inflated, with strongly prosocoelus beaks; sculptured with about 27 radial close-set ribs with narrower interspaces; a smooth, deep lunar impression in front of, and a narrow, escutcheon-like smooth area behind them, the whole surface minutely granulose; basal margin angularly produced near the middle, internally minutely fluted in harmony with ribs; hinge normal; Alt. 4.75, long. 4.5, diam. 4.6 mm.

Type locality.—Bowden, Jamaica.

One of the broken valves of this species that is much larger than the cotypes has the following dimensions: length 12.5 mm.; height 12 mm.; diameter 5.5 mm. Adult shells have less conspicuous marginal fluting and the basal angle is more or less straightened.

V. jamaicensis resembles in general features the type of the subgenus, *V. fischeriana* Dall, but is smaller and has a more angular base and flatter umbos.

Type material.—3 cotypes (U. S. Nat. Mus. No. 135688).

Superfamily ASTARTACEA.

Family CRASSATELLITIDAE.

Genus CRASSATELLITES Krueger.

Subgenus CRASSATELLITES s. s.

Krueger, 1823, Geschichte der Urwelt, part 2, p. 466.

Type.—Crassatellites sinuatus Krueger (=*Crassatella gibbosula* Lamarck). Eocene, Paris Basin.[1]

The following is a description of the subgenus *Crassatellites* s. s.:

Shell heavy, medium-sized or large, subquadrate or subtrigonal, inequilateral; umbos low, rounded; lunule and escutcheon depressed; sculpture consisting of concentric lamellae or rugae; cardinal area wide; ligament and resilium internal, adjacent, seated on a large deep subumbonal chondrophore; hinge of right valve consisting of 3 cardinals, the anterior

[1] The description is based on *Crassatella gibbosula* Lamarck.

(3*a*)[1] and middle (1) ones fused and diverging at an acute angle, the posterior one (3*b*) reduced to a ridge along lower edge of chondrophore; hinge of left valve consisting of 2 cardinals (2*a* and 2*b*) separated by a wide, deep socket, the posterior one forming a ridge along anterior edge of chondrophore; right valve bearing an obscure anterior and posterior lateral; left valve bearing a long posterior lateral and a less distinct anterior lateral; adductor scars deeply depressed; inner margin of valve finely corrugated.

Many of the American Tertiary species are more elongate and more rostrate than the type species, and have no vestige of a right posterior cardinal (3*b*) and no corrugations on the inner margin of the valve. Dall has placed these species in the section *Scambula.* The name *Scambula* was proposed by Conrad[2] for an Upper Cretaceous species, *S. perplana* Conrad, from New Jersey. This species has also been found in Upper Cretaceous deposits in Georgia and Tennessee. It is very small, unusually flat, has a different hinge, and in general features resembles *Crassinella.* The name *Scambula* can be used only for this peculiar Upper Cretaceous shell. The difference between the Bowden species, which belong to the group that has been called *Scambula,* and the type of *Crassatellites* hardly warrants a new section name.

The living species of *Crassatellites,* also known as *Crassatella,* are restricted to the warm seas. It formerly had a more extensive distribution in the northern hemisphere, where it was conspicuous in virtually all Eocene, Oligocene, and Miocene faunas.

Key to the Bowden species of Crassatellites s. s.

Posterior dorsal margin slightly excavated..... *C.* (*C.*) *jamaicensis*
Posterior dorsal margin deeply excavated..... *C.* (*C.*) *altaspissus*

Crassatellites (Crassatellites) jamaicensis Dall.

(Plate 11, Figures 12 to 15.)

Crassatellites (*Scambula*) *jamaicensis* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1471-1472, plate 49, fig. 13.

The following is the original description of this species:

Shell small, nearly equilateral, subtrigonal, rounded below and in front with posterior end obliquely subtruncate and a feeble carina bounding the posterior dorsal area; lunule and escutcheon subequal, moderately impressed; nepionic shell flattened, with 7 or 8 concentric low undulations, which extend down about one-fourth of the way to the basal margin mesially, and on the anterior slope are continuous, though the greater part of the disk and the whole of the posterior dorsal area are smooth except for incremental lines; hinge normal, the posterior right cardinal nearly obliterated; laminar grooves deep; internal margins of the valves smooth. Lon. 49, alt. 37, diam. 20 mm.

Type locality.—Bowden, Jamaica.

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[1] The symbols in parenthesis refer to the notation for cardinal teeth originally used by Bernard and Munier-Chalmas. Many of the notations are adapted from Cossmann and Peyrot.

[2] T. A. Conrad. Amer. Jour. Conch., vol. 5, p. 48. 1869.

The shell is slightly depressed in front of the posterior ridge, but not enough to affect the margin. Between the ridge and the escutcheon lies a fainter ridge; midway between the two ridges is a faint shallow groove on the ventral half of the shell. The relative width of the lunule and escutcheon is variable, but they are subequal in length and the lunule usually is more deeply depressed. On the largest valve the concentric undulations are somewhat irregular on the ventral half of the anterior slope. The middle cardinal (1) on the right valve is very small.

Dall has described a similar species from the Chipola formation—*C. chipolanus*. It has fine concentric undulations on the entire surface, except on the posterior slope. On some shells the concentric sculpture may disappear or may be present on only the anterior third or less of the shell. Such shells differ from *C. jamaicensis* by having from 2 to 4 very coarse undulations a short distance from the tip of the umbo, which may be smooth or feebly undulated; and the undulations down the anterior slope, if present, are finer than those on the Bowden species; in addition the umbos are slightly lower; the lunule narrower, and the hinge not so heavy.

Specimens of this species in Guppy's collections were labeled "*C. marylandicus* Conrad," but that species is very different.

Type material.—4 cotypes (U. S. Nat. Mus. No. 135683).

Crassatellites (Crassatellites) altaspissus, new species.

(Plate 11, Figures 16, 17.)

The following is a description of this species:

Shell medium-sized, heavy, moderately inequilateral; posterior margin obliquely truncated, base slightly emarginate in front of posterior ridge; umbos high, incurved, the apex flattened; escutcheon slightly wider and longer than lunule, both moderately depressed; posterior ridge low; a lower and broader ridge extends from the umbo to the upper edge of the posterior truncation; sculpture consisting of 9 concentric undulations in the umbonal region, the ventral few slightly crowded; on the anterior slope finer concentric undulations extend almost half of distance from umbo to ventral margin, remainder of shell smooth except for incrementals; hinge high, massive, the right posterior cardinal (3*b*) absent; inner margin of valve smooth.

Length 61 mm.; height 45 mm.; diameter (right valve) 18 mm.

This species, which is based on an adult right valve and a young right valve, closely resembles *C. densus* Dall, described from the Oak Grove sand of Florida, but is proportionally higher, more convex and has a more excavated posterior dorsal margin, longer posterior truncation, and more numerous and finer umbonal concentric undulations. The undulations on the anterior slope of *C. altaspissus* are coarser, but the change from one series to the other is not abrupt as on *C. densus*. *C. altaspissus* is distinguished from *C. jamaicensis* by its more elongate outline, more excavated posterior dorsal margin, and by

the presence of concentric undulations on only the upper half or less of the anterior slope. It has essentially the same outline as the Miocene species from Panama and Costa Rica called *C. reevei* by Olsson, but does not have concentric rugae on the anterior part of the shell.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352797).

Genus CRASSINELLA Guppy.

Guppy, 1874, Geological Magazine, decade 2, vol. 1, p. 442; 1875, Geological Magazine, decade 2, vol. 2, p. 42.

Type.—*Thetis parva* C. B. Adams (?=*Crassatella martinicensis* d'Orbigny). Recent, West Indies.

The following is a description of the genus *Crassinella:*

Shell small, flattened, rounded triangular, slightly inequilateral; posterior dorsal margin excavated; lunule and escutcheon flattened; umbos acute; sculpture consisting of concentric lamellae; cardinal area narrow; ligament and resilium internal; chondrophore small; hinge consisting of 2 cardinals in each valve; cardinals of left valve (2*a* and 2*b*) separated by chondrophore, cardinals of right valve (3*a* and 1) lying in front of chondrophore; right valve bearing an anterior lateral, and left valve a posterior lateral; on the left valve a low median ridge separates the chondrophore from the socket in front of it; inner margin of valve smooth.

As *Crassinella* was proposed to replace the preoccupied name *Gouldia* C. B. Adams,[1] which C. B. Adams had used for the preoccupied name *Thetis* C. B. Adams,[2] it is necessary to use as the type one of the species originally included under the name *Thetis*. Adams listed 2 new species, *Thetis cerina* and *Thetis parva,* both from Jamaica. *Thetis parva* is herewith designated the type. It closely resembles and may be identical with *Crassatella martinicensis* d'Orbigny.

These small bivalves, also known as *Crassitina,* are abundant in the Tertiary faunas of Europe and America. They are living in the tropical and temperate waters of the Atlantic.

Key to the Bowden species of Crassinella.

Posterior dorsal margin excavated, sculpture consisting of widely spaced, sharp-crested lamellae..... *C. guppyi*
Posterior dorsal margin not excavated.
  Shell slightly inflated; sculpture consisting of crowded, irregularly spaced rugae or lamellae..... *C. bowdenensis*
  Shell strongly inflated; sculpture consisting of regularly spaced rugae..... *C. xena*

Crassinella guppyi (Dall).

Plate 11, Figures 18 to 20.)

Crassatellites (*Crassinella*) *Guppyi* Dall, in Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 326, plate 30, fig. 5. Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1476.

Not *Crassinella guppyi* Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 361, plate 52, fig. 21.

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[1] C. B. Adams. Catalogue of the genera and species of recent shells in the collection of C. B. Adams, p. 29 (footnote). 1847.

[2] C. B. Adams. Proc. Boston Soc. Nat. Hist., vol. 2, p. 9. 1845.

The following is the original description of this species:

Rounded trigonal, flattish, concentrically costate, with 10 to 12 lamellar ribs, much narrower than the interstices. Alt. 4.6, lon. 4.6 mm.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell small, compressed or slightly inflated, outline irregularly rounded-triangular, moderately inequilateral; posterior dorsal margin usually slightly longer than anterior and excavated, especially on right valve, meeting ventral margin at a sharp or subrounded angle; anterior dorsal margin straighter or slightly convex, rounding into the asymmetrically arcuate base; umbos relatively high, acute and compressed; escutcheon usually wider and more deeply flattened than lunule; sculpture of adult valve consisting of 8 to 16 sharp-crested concentric lamellae, which are crowded and occasionally interrupted near ventral margin.

Length 4.8 mm.; height 4.5 mm.; diameter (right valve) 1 mm.

The largest valve has the following dimensions: length 6 mm.; height 5.6 mm.; diameter (right valve) 1.2 mm. This species resembles the living West Indian *C. guadalupensis* d'Orbigny, but is smaller, more inflated and has lower umbos and less regularly spaced concentric lamellae. The same differences separate it from *C. lunulatus* (Conrad), a Miocene and Pliocene species from the Middle Atlantic States. The dorsal margin of *C. acutus* Dall, which was described from Pliocene beds in Florida, met at a more acute angle. The species listed by Guppy as *C. martinicensis* d'Orbigny from Matura, Trinidad, has rounded concentric lamellae.

C. guppyi is larger than the species described by Maury as *"C. guppyi"* from the Cercado formation of the Dominican Republic, and has more deeply excavated posterior dorsal slopes and coarser sculpture. Apparently the same species as Maury's *"C. guppyi"* was collected from the Gurabo formation by the U. S. Geological Survey party. *C. guppyi radiata* Pilsbry, a subspecies from an unknown Miocene horizon in the Dominican Republic, has fine radial striae.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 107151).

Crassinella bowdenensis (Dall).

(Plate 12, Figures 1 to 4.)

Crassatellites (*Crassinella*) *bowdenensis* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1476, plate 50, figs. 2, 3.

The following is the original description of this species:

Shell small, thick and solid, plump, subequilateral, the anterior side a little shorter, beaks small, acute, recurved; lunule and escutcheon lanceolate, subequal, well impressed, smooth; valves with subequal dorsal slopes and prominently arcuate base, sculptured with concentric, close-set,

flattened threads, which near the umbos are less crowded and slightly sharper; hinge solid, strong, normal. Height, 3.5, length, 3.7, diameter 2.0 mm.

Type locality.—Bowden, Jamaica.

Some shells are almost equilateral and their sculpture consists of fine concentric rugae. On other shells the posterior dorsal margin is slightly concave and the umbo is not so full. The sculpture may resolve itself into rather widely spaced sharp lamellae, thus approaching the sculpture of *C. guppyi,* though not so coarse.

C. bowdenensis is more convex and more triangular than *C. bowdenensis costaricensis* Olsson, a Miocene Costa Rican subspecies. *C. bowdenensis* resembles *C. triangulatus* Dall, a Chipola marl species, but is more inflated, and has stronger and more regular sculpture. It is larger and more inflated than *C. martinicensis* (d'Orbigny), the living West Indian species, and has less uniform sculpture.

Type material.—4 cotypes (U. S. Nat. Mus. No. 135685).

Crassinella xena, new species.
(Plate 12, Figures 5, 6.)

The following is a description of this species:

Shell small, high, slightly inequilateral, obliquely rounded-triangular; posterior dorsal margin longer, slightly convex; umbos full, acute, decidedly opisthogyrate; escutcheon slightly broader and shorter than lunule, both moderately flattened; adult shell sculptured with 15 to 18 prominent, evenly spaced rounded rugae, separated by narrower interspaces.

Length 2.8 mm.; height 2.6 mm.; diameter (left valve) 0.9 mm.

This species resembles *C. microdelta* (Pilsbry and Johnson), which was collected by the U. S. Geological Survey expedition from the Cercado formation on Rio Caña, Dominican Republic, but has more acute umbos and coarser sculpture. A similar species was collected from the Gurabo formation on Rio Gurabo, Dominican Republic. *C. xena* also closely resembles *C. duplinianus* (Dall), from the Duplin and Waccamaw marls of North Carolina, but is less inflated, more elongate and has more acute umbos.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352798).

Superfamily CARDITACEA.

Family CARDITIDAE.

Genus CARDITA Lamarck.

Section CARDITA s. s.

Lamarck, 1799, Mémoires de la Société d'Histoire Naturelle de Paris, p. 86.

Type (by monotypy).—Chama calyculata Linné. Recent, Mediterranean Sea.

The following is a description of the section *Cardita* s. s.:

Shell medium-sized, mytiloid, very inequilateral, ventral margin insinuated and slightly gaping at anterior end; lunule very small, deeply de-

pressed, limited by deep groove; sculpture consisting of beaded radial ribs; hinge of right valve consisting of 2 cardinals, the posterior one (3*b*) elongate and club-shaped, the anterior one (3*a*) partly fused to border of lunule, and an obscure anterior lateral; hinge of left valve consisting of 2 cardinals, the posterior one (4*b*) elongate, the anterior one (2) obscurely bifid, and a small pointed anterior lateral; inner margin of valve coarsely fluted except at byssal gape.

Cardita s. s. is not represented in the Bowden formation. There are no living West Indian or east American species. *C. caribbeanensis* Olsson, recently described from the Gatun formation of Costa Rica, is the only American fossil species.

Section GLANS Megerle von Mühlfeld.

Megerle von Mühlfeld, 1811, Gesellschaft naturforschender Freunde zu Berlin, Magazin für die neuesten Entdeckungen in der gesammten Naturkunde, year 5, p. 68.

Type (*by monotypy*).—*Chama trapezia* Gmelin. Recent, Mediterranean Sea.

The following is a description of the section *Glans:*

Shell medium-sized, subquadrate, inequilateral, strongly inflated, posterior margin truncated; lunule small, deeply depressed; sculpture consisting of strongly beaded radial ribs; hinge of right valve consisting of 2 cardinals, the posterior one (3*b*) elongate trigonal, the anterior one (3*a*) almost completely fused to the hinge margin, and double anterior and single posterior laterals; hinge of left valve consisting of 2 cardinals, the posterior one (4*b*) elongate, and single anterior and double posterior laterals; inner margin of valve coarsely fluted.

The outline of the shell and the prominent laterals separate this section from *Cardita* s. s. The hinge of the Bowden species, *C. scabricostata* differs from the hinge of the type, as its right anterior cardinal (3*a*) is more distinct; the right posterior cardinal (3*b*) is less trigonal; and the left anterior cardinal (2) is more trigonal. *C. scabricostata* has commonly been placed in the genus *Venericardia,* probably because of its outline, although it has much more prominent laterals than *V. imbricata* (Gmelin), the type of *Venericardia.* The hinge of *C. scabricostata* closely resembles the hinge of species like *C. intermedia* (Brocchi), from the Pliocene of Italy.

Living species of *Cardita* (*Glans*), which like the fossil species frequently are called *Venericardia,* are widely distributed.

Cardita (Glans) scabricostata Guppy.

(Plate 12, Figures 7 to 9.)

Cardita scabricostata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol 22, p. 293, plate 18, fig. 10. Guppy (part), 1874, Geol. Mag., dec. 2, vol. 1, p. 442, (list). Not Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 252 (= *C. islahispaniolae* Maury). Not Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531 (= *C. islahispaniolae* Maury).

Venericardia scabricostata (Guppy), Dall (part), 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1428. ? Hubbard, 1921, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 2, p. 108, New York Acad. Sci. Not Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 362, plate 59, fig. 1. Not Olsson, 1922, Bull. Amer. Paleontology, vol. 9, pp. 388–389, plate 32, figs. 14, 17.

The following is the original description of this species:

Shell suborbicular, nearly as high as wide, with about 18 regularly nodosely nuricate impressed ribs; posterior margin nearly straight, forming an angle with the ventral margin, which is rounded; anterior margin rounded; umbos prominent; margins strongly crenate, hinge with 2 teeth, of which the posterior one is long and narrow.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell small, moderately inflated, very inequilateral, subquadrate; anterior margin rounding broadly into base, base slightly curved and subparallel to the gently curved posterior dorsal margin; posterior margin obliquely subtruncate, joining dorsal margin by a broad curve; umbos almost at anterior end of shell, moderately wide and high; lunule small, deeply depressed; sculpture consisting of 19 to 22 radial ribs bearing strong rounded transverse beads; first few anterior ribs separated by wider interspaces; succeeding ribs up to the posterior slope terraced on both sides, the beaded part forming a rounded keel, interspaces slightly narrower; beyond the posterior slope the lower terraced part of the ribs disappears, the ribs are reduced in width, and the interspaces become correspondingly wider, the last 3 posterior ribs suddenly widen and bear beads that are more compressed at their ends or even spinose and are directed toward the posterior margin; on the terraced ribs the beads continue across the terraces as obscure undulations; very fine concentric striae and coarser, irregular concentric threads lie on the terraces and in the interspaces; hinge of right valve consisting of 2 cardinals, the anterior one (3*a*) small and partly fused to the hinge-margin, the posterior one (3*b*) elongate, and anterior and posterior laterals, the anterior one double; hinge of left valve consisting of 2 cardinals, the anterior one (2) trigonal, the posterior one (4*b*) narrow and elongate, and anterior and posterior laterals, the posterior one double.

Length 19 mm.; height 19.2 mm.; diameter (left valve) 6.2 mm.

On some shells a small secondary radial lies in one of the two interspaces near the posterior margin. Young valves are more orbicular than adults; the terrace on their median ribs is indistinct; and the beads on the ventral part of the posterior ribs are more scaly.

C. scabricostata is very similar to a common species in the Gurabo formation of the Dominican Republic, which has been described as *Venericardia islahispaniolae* by Maury. The Bowden species is smaller and has more strongly terraced ribs, smaller left anterior cardinal (2), and stronger laterals, which are more distant from the cardinals. The species described as *"Venericardia scabricostata"* by Maury from the Cercado formation is entirely different. It is more orbicular than the Bowden species and has unterraced ribs and weak

laterals. The Miocene species from Costa Rica described by Olsson as *"Venericardia scabricostata"* is not at all similar to the Bowden species.

The small *"Venericardia"* from the Lares limestone (middle or upper Oligocene) of Porto Rico described by Hubbard probably is a different species.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64087).

Genus VENERICARDIA Lamarck.

Subgenus VENERICARDIA s. s.

Lamarck, 1801, Systême des Animaux sans Vertèbres, p. 123.

Type (by subsequent designation, Gray 1847).—Venus imbricata Gmelin. Eocene, Paris Basin.

The following is a description of the subgenus *Venericardia* s. s.:

Shell thick, medium-sized, cardiform, orbicular-rhomboidal, strongly inflated; umbos prosogyrate; lunule very small, deeply depressed, bounded by a deep groove; sculpture consisting of beaded radial ribs; hinge-platform wide; hinge of right valve consisting of 2 cardinals, the anterior one (3*a*) very small, the posterior one (3*b*) elongate, and an obscure posterior lateral; hinge of left valve consisting of 2 cardinals, the posterior one (4*b*) elongate, and an obscure anterior and posterior lateral; inner margin of valve coarsely fluted.

There are no Bowden species of *Venericardia* s. s.

Subgenus PLEUROMERIS Conrad.

Conrad, 1867, American Journal of Conchology, vol. 3, p. 12.

Type (by monotypy).—Pleuromeris decemcostata Conrad (=*Cardita tridentata* Say). Miocene and Pliocene, middle Atlantic states.

The following is a description of the subgenus *Pleuromeris:*

Shell small, cardiform, slightly inequilateral, strongly inflated; lunule and escutcheon small, lunule limited at hinge-margin by a ridge; sculpture consisting of strongly beaded radial ribs; hinge of right valve consisting of a central large trigonal cardinal (3*b*) and double anterior and single posterior laterals; hinge of left valve consisting of an anterior (2) and posterior (4*b*) cardinal, the posterior one elongate, and single anterior and double posterior laterals; inner margin of valve coarsely fluted.

The Bowden species *V. acaris* Dall has been placed in the subgenus *Pteromeris* Conrad, the type of which, *V. radians* Conrad (=*V. perplana* Conrad), is flattened and has bifid cardinals. *V. acaris* is more inequilateral than the type of *Pleuromeris* and has a thickened ridge at the inner margin of the escutcheon. The hinges of the two species are similar, although the left anterior cardinal (2) of the Bowden species is more elongate.

Pleuromeris is an American group of small Venericardias first appearing in the Eocene.

Venericardia (Pleuromeris) acaris Dall.

(Plate 12, Figures 10 to 12.)

Venericardia (*Pteromeris*) *acaris* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1434, plate 56, fig. 4.

The following is the original description of this species:

Shell small, plump, inequilateral, the full but rather low beaks situated near the posterior third; anterior end longer, obliquely produced, rounded, posterior dorsal border descending much more steeply, subangular at the lower posterior termination; sculpture of about 18 broad, flattened radial ribs separated by narrow sulci and crossed by small, arcuate, raised threads, convex dorsally, the ends of these threads projecting sometimes gives a punctate effect to the sulci; there is a small, narrow lunule and escutcheon apparently quite smooth; hinge normal, the lateral distinct; the inner margins sharply crenulate, the ligament and resilium wholly external. Length 2.5, height 2.5, diameter 2.0 mm.

Type locality.—Bowden, Jamaica.

The sculpture consists of 18 to 20 ribs, ornamented with low rounded beads. A short row of oblique rugae representing the beads of the adjoining ribs extends along the margin of the lunule. At the margin of the escutcheon lies a similar but shorter row. The lunule is sharply set off from the sculptured part, but the escutcheon, which is longer and narrower than the lunule, usually is less distinct. Both lunule and escutcheon have a thickened ridge at the hinge, especially on the right valve. The height of the shell usually exceeds the width.

This species is less orbicular and has narrower interspaces than *V.* (*P.*) *conradiana* Gabb,[1] from Costa Rica.

Type material.—5 cotypes (U. S. Nat. Mus. No. 135677).

Superfamily CHAMACEA.

Family CHAMIDAE.

Genus CHAMA Linné.

Linné, 1758, Systeme Naturae, ed. 10, p. 691.

Type (*by subsequent designation, Gray 1847*).—*Chama lazarus* Linné. Recent, Indian Ocean.

The following is a description of the genus *Chama:*

Shell medium-sized, orbicular, inequivalve, attached by left valve; apex dextrally twisted when shell is viewed in attached position; sculpture consisting of foliaceous concentric lamellae; prodissoconch very small, generally sculptured with closely spaced radial threads and more distant concentric lamellae; hinge of right valve consisting of a long curved tooth paralleling the hinge-margin, its lower side roughened, obscurely divided into two parts, a small narrow tooth lying above the larger one, and a

[1] W. M. Gabb. Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 377, plate 47, fig. 79. 1881. Gabb's specimen came from beds considered of Pliocene age, but at that time it was not known that Miocene beds crop out at Limon. *V.* (*P.*) *conradiana limonensis* Olsson (Bull. Amer. Paleontology, vol. 9, p. 389, plate 29, figs. 19, 20, 1922), from beds of known Miocene age at Limon, may be the same form.

rudimentary posterior lateral; hinge of left valve consisting of a heavy tooth at the base of the hinge plate, grooved on its upper side, a longer tooth-like mass paralleling the ligament, obscurely divided into two parts, and a rudimentary posterior lateral;[1] posterior adductor scar more elongate than anterior.

The living species of *Chama,* like the Teritary species, are widely distributed in the warm shallow seas. They are most abundant among coral reefs.

Key to the Bowden species of Chama.

Shell small, sculpture of right valve not spinose..... *C. involuta*
Shell large, sculpture of right valve spinose..... *C. macerophylla*

Chama involuta Guppy.

(Plate 12, Figures 13 to 17.)

Chama macrophylla Gabb (part, not Chemnitz), 1873, Trans. Amer. Philos. Soc. n. s., vol. 15, p. 251.

Chama involuta Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, part 2, p. 86, plate 2, fig. 5. Guppy, 1874, Geol. Mag. decade 2, vol. 1, p. 436, plate 17, figs. 5*a*-5*c*; p. 442 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531. Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1398. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 363, plate 59, figs. 4 to 6. ? Hubbard, 1921, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 2, p. 109, New York Acad. Sci. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 416.

The following is the original description of this species:

Left (attached) valve deep internally, very convex externally, often spiral, completing a turn and a half, covered externally with distant large foliaceous scales more or less erect, between which are small irregular diverging granose ridges. Right valve patulous, ornamented with numerous close concentric sinuous foliaceous laminae. Umbos large, prominent, spiral. Margin and laminar cardinal tooth crenate.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell small, thin or moderately heavy, usually suborbicular or elongate-subovate; left valve attached, irregular, very convex, umbos prominent, strongly twisted; sculpture consisting of relatively coarse, slightly imbricating concentric lamellae, at intervals extended and elevated into short scales arranged in more or less obscure radial series; irregular interrupted swollen radial threads extend over the lamellae; right valve compressed or moderately inflated in umbonal region; sculptured with closely spaced projecting frilled lamellae; inner margin of right valve finely corrugated; on the left valve corrugations usually are absent on the margin, except on the upper posterior margin, and on some valves faint radial threads are visible on the inner surface.

A left valve: length 12 mm.; height 14 mm.; diameter 5.8 mm. A right valve: length 11.7 mm.; height 12.5 mm.; diameter 4.8 mm.

[1] Dentition after Odhner, 1918 (see reference on p. 105).

Some of the numerous valves of this species are larger than the ones measured. The largest left valve has the following dimensions: length 18 mm.; height 20.5 mm.; diameter 10 mm.

The sculpture of the attached (left) valve is very irregular. The radial scales, which rarely are extended forming spines, may disappear, but the peculiar pustular radial sculpture usually persists. On right valves the number of concentric lamellae and the relative coarseness of the flutings vary. The prodissoconch is preserved on a few shells. It is small, subquadrate; umbo at anterior end; sculpture consisting of 6 to 7 distant, regularly spaced, sharply raised, and slightly recurved concentric lamellae and intervening obscure, fine concentric striae; radial sculpture obscure.

The small size, vermicular, scabrous, or spiny sculpture of the attached left valve, and the numerous finely fluted lamellae of the right valve are characteristic features of this species. Shells from both the Cercado and Gurabo formations of the Dominican Republic seem to be this species. The Cercado shells are smaller than shells from Bowden. The concentric lamellae on the left valves of Gurabo shells are more distant than on Bowden shells and the sculpture of right valves is less foliaceous, but the prodissoconchs are similar. The left valve of *C. chipolana* Dall, described from the Chipola formation of Florida, has more numerous radials and larger spines; the right valve has less foliaceous concentric sculpture. It is not likely that the large *Chama* described by Hubbard from the Quebradillas limestone (lower Miocene) of Porto Rico is the Bowden species.

Other localities.—Cercado (lower Miocene), and Gurabo (middle Miocene) formations, Dominican Republic.

Type material.—11 cotypes (U. S. Nat. Mus. No. 115537).

Chama macerophylla Gmelin.

(Plate 12, Figures 18, 19.)

Macerophylla, Flos Macis, etc., Chemnitz, 1784, Conch. Cab., vol. 7, pp. 101, 149, plate 52, figs. 514, 515.

Chama macerophylla Gmelin, 1792, Syst. Nat., ed. 12, vol. 6, p. 3305. Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1403–1404.

Chama citrea Gmelin, 1792, Syst. Nat., ed. 12, p. 3305.

Chama macrophylla Gmelin, Hanley, 1843, Descr. Cat. Rec. Biv. Shells, p. 226. Reeve, 1846–1847, Conch. Icon., vol. 4, *Chama,* plate 2, fig. 6; plate 8, fig. 6*b*. d'Orbigny, 1853, in de la Sagra, Hist. phys., polit. et natur. de l'Ile de Cuba, Mollusques, vol. 2, p. 363. (French ed.). Gabb (part), 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 251. Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 375.

The following is the original description of this species:

Ch. testa rotundata seriatim lamellata, margine interno crenulata.

The following is a description of a Bowden specimen of this species:

Shell medium-sized, irregularly subovate; attached by left valve; right valve moderately convex at posterior end, compressed toward anterior

margin; umbo large for size of shell, twisted about one and a half turns; sculpture consisting of irregular, more or less overlapping concentric lamellae, frilled and extended at irregular intervals into spines bearing fine obscure radial striae.

Right valve: length 27 mm.; height 23 mm.; diameter 8 mm.

A right valve seems to be this species. The much larger size, larger umbo, more foliaceous and spinose lamellae bearing fine radial striae, separate this valve from right valves of *C. involuta.*

Other localities.—Miocene, Dominican Republic. Pliocene, Limon, Costa Rica. Pleistocene, the Antilles and Curaçao. Living, Tampa to Curaçao and Santa Marta in shallow water to 287 fathoms.

Genus ECHINOCHAMA Fischer.

Fischer, 1887, Manuel de Conchyliologie, p. 1049.

Type (by monotypy).—Chama arcinella Linné. Recent, West Indies.

The following is a description of the genus *Echinochama:*

Shell medium-sized, suborbicular, subequivalve, adult not attached, young shell attached by right valve; umbos strongly prosogyrate; lunule large, deeply depressed; sculpture consisting of pits and spinose radial ribs; prodiscoconch large, elongate; hinge of right valve consisting of a heavy furrowed anterior callosity, a posterior row of denticles paralleling the ligament, and a rudimentary posterior lateral; hinge of left valve consisting of an anterior row of small denticles, a furrowed socket, a heavy posterior tooth, its upper surface denticulate and its inner surface furrowed, and a rudimentary posterior lateral;[1] margin of valve coarsely fluted; inner margin finely corrugated.

Echinochama is a strictly American tropical group of Chamas. One species (the genotype *E. arcinella*) lives in the West Indies, and another species (*E. californica* Dall) lives on the Pacific coast off Lower California. The genus first appears in lower Miocene deposits in the West Indies (Cercado formation, Dominican Republic). It is conspicuous in the middle Miocene deposits of the West Indies and Central America. The living *E. arcinella* occurs in the Shoal River formation (middle Miocene) and Choctawhatchee marl of Florida. As *Echinochama* is a characteristically tropical genus, these deposits may have been laid down in warm temperate waters.

As a result of an extensive study of the Chamidae, Odhner[2] has restricted the name *Chama* to the so-called "normal" Chamas attached by the left valve, and proposed the new genus *Pseudochama* for the "inverse" Chamas attached by the right valve. According to Odhner, *Echinochama* is a modified *Pseudochama,* and he considered

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[1] Dentition after Odhner, 1918 (see reference below).

[2] N. H. J. Odhner. Results of Dr. E. Mjöbergs Swedish scientific expenditions to Australia 1910–1913, XVII, Mollusca: Kungl. Svenska Vetenskapsakademiens Handlingar, vol. 52, No. 16: pp. 28–31. 1917. Studies in the morphology, the taxonomy, and the relations of Recent Chamidae, Kungl. Svenska Vetenshapsakademiens Handlingar, vol. 59, No. 3, 102 pp., 8 plates. 1918.

it a subgenus of *Pseudochama.* This arrangement violates the rules of nomeclature, as *Echinochama,* the earlier name, would have to be the generic name and *Pseudochama* the subgeneric. *Echinochama* is the only representative of the "inverse" Chamas in the Bowden formation.

Echinochama antiquata Dall.

(Plate 13, Figures 1 to 4.)

Chama arcinella Guppy (not Linné), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 294. Guppy (part, not Linné), 1874, Geol. Mag. decade 2, vol. 1, p. 442 (list).

Echinochama antiquata Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1404–1405, plate 54, fig. 9. ? Maury, 1920, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 1, p. 30, New York Acad. Sci. Not Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 365, plate 59, fig. 10 (= *E. trachyderma* Pilsbry and Johnson). Not Olsson, 1922, Bull. Amer. Paleontology, vol. 9, pp. 390–391, plate 31, fig. 8.

The following is the original description of this species:

Shell large, subquadrate, with an almost obsoletely rectilinear base, slightly arched posterior and dorsal edges, and excavated anterior end; valves less convex than in *E. arcinella* and with less prominent and inflated beaks, larger and impressed lunule; the number of ribs varies from 22 to 31, low with subequal interspaces, the spines very short and scale-like, except on a single median rib, where they are triangular and somewhat longer than on the rest; surface sculpture more pustular and less regular than in *E. arcinella.* Length 50, height 48, diameter about 40 mm. exclusive of the spines.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell large, massive, equivalve, inequilateral; umbos anterior, moderately inflated and moderately high; lunule large, deeply depressed, its median part raised toward margin; sculpture consisting of 20 to 30 low, rounded radial ribs, separated by interspaces of about the same width; on the posterior half of shell the ribs are small, but increase in width toward center where there is a prominent rib; on the anterior half the ribs are fewer, but wider and higher, and decrease in size anteriorly, but near the margin of the lunule again becoming larger; on the dorsal margin of the right valve are 1 or 2 more or less irregular ribs, much more prominent than adjoining ones; ribs ornamented with short lamellar spines, most prominent on the large median rib and on the posterior ribs, often taking the form of small irregular beads; interspaces and lunule irregularly pitted; concentric sculpture consisting of irregular slightly imbricating lamellae near margins and continuing across lunule; ventral margin of the shell slightly undulated by the anterior ribs; inner margin finely corrugated.

Length 52.5 mm.; height 52 mm;. diameter (right valve) 21 mm.

The large massive shells of this species are very conspicuous. The prominent irregularly spinose rib, or ribs, adjacent to the dorsal margin, is a constant feature on right valves, but is absent on left

valves. Some shells have a shallow groove near the dorsal margin. The part of the shell between this groove and the prominent median rib is slightly raised. Traces of reddish-brown coloration are visible on the interior surface of one valve.

The differences between *E. antiquata* and *E. arcinalla* (Linné), the living West Indian species, are discussed by Dall. In addition, *E. antiquata* has more numerous, narrower ribs and much shorter spines. Young shells of the Bowden species have fewer ribs and relatively longer spines than adults and therefore more closely resemble the living species. The Bowden species is similar to the living West Coast species, *E. californica* Dall, but has more numerous and shorter spines. *E. trachyderma* Pilsbry and Johnson, which has been confused with *E. antiquata,* is confined to the Gurabo formation in the Dominican Republic. It has fewer and less spinose ribs than the Bowden species, and the exterior is more pitted. In the smaller species, *E. yaquensis* Maury, which also is confined to the Gurabo formation, these differences are more pronounced. The Miocene species from Costa Rica, described by Olsson as *E. antiquata,* is smaller than specimens from Bowden and has fewer ribs. An internal cast from Porto Rico was referred by Maury to *E. antiquata.*

Type material.—6 cotypes (U. S. Nat. Mus. No. 135740).

Superfamily LUCINACEA.

Family LUCINIDAE.

Genus CODAKIA Scopoli.

Section CODAKIA s. s.

Scopoli, 1777, Introductio ad Historiam naturalem, sistens genera Lapidum, Plantarum et Animalium hactenus detecta, caracteribus essentialibus donata, in tribus divisa, subinde ad leges Naturae, p. 398.

Type (*by monotypy*).—*Chama codok* Adanson (?=*Venus punctata* Linné). Recent, west coast of Africa.[1]

The following is a description of the section *Codakia* s. s.:

Shell large, suborbicular, moderately inflated; lunule small, deeply depressed; sculpture consisting of radial grooves and striae, crossed by incrementals; ligament and resilium large, deeply inset; hinge of right valve consisting of a prominent anterior lateral close to the cardinals, anterior (3*a*) and middle (3*b*) cardinals, and a small posterior lateral; hinge of left valve consisting of large double anterior laterals, anterior (2) and middle (4*b*) cardinals, and small double posterior laterals; inner margin of valve slightly wrinkled.

Codakia s. s. is a tropical genus living in West Indian and west African waters. During Tertiary time it was more widely distributed, as several species are recorded from the Mediterranean region and other parts of Europe. The earliest European species is of Eocene

[1]The description is based on *Venus punctata* Linné.

age, but Miocene deposits have furnished the earliest American species.

Key to the Bowden species of Codakia s. s.

Shell weakly sculptured..... *C. (C.) spinulosa*
Shell strongly sculptured..... *C. (C.) lomonea*

Codakia (Codakia) spinulosa Dall.

(Plate 13, Figures 5, 6.)

Codakia spinulosa Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1346-1347, plate 52, fig. 19.

The following is the original description of this species:

Shell nearly orbicular, moderately and regularly convex, solid, with pointed, low, prosogyrate beaks; lunule small, deep, cardiform; sculpture of small, low, flattish, indistinct radials with slightly excavated, narrower interspaces; these are crossed by indistinct, concentric threads, incremental lines, and occasional ridges due to resting stages; at what would be the intersections if the concentric sculpture were better developed, the shell shows small, squarish nodulations which towards the ends and dorsal margins become minutely spinulose; the right valve has the hinge well developed, the anterior lateral large and strong, the posterior obsolete; the posterior cardinal slightly grooved; margin with traces of crenulation anteriorly; scars normal. Height 28.0, length 29.0, diameter 12.0 mm.

Type locality.—Bowden, Jamaica.

This species is known only from one right valve. The concentric sculpture consists of pustular beads that are eroded from part of the shell. The characteristic features are the pustular sculpture and small deep lunule. There is no possibility of confusing this species with the living West Indian *C. orbicularis* (Linné), which ranges back to the Pliocene, because of the much smaller size, more rounded outline, and less pronounced sculpture of the Bowden species.

Type material.—5 cotypes, 4 of which represent a species of *Phacoides* (*Parvilucina*) (U. S. Nat. Mus. No. 135713).

Codakia (Codakia) lomonea, new species.

(Plate 13, Figures 7, 8.)

The following is a description of this species:

Shell small, suborbicular, weakly inflated, anterior end more extended and more convexly rounded; lunule narrow, moderately depressed; sculpture consisting of 32 strong radials of varying width, separated by narrower interspaces; ribs bearing relatively coarse beads arranged along equally spaced concentric lines, the beads becoming compressed and sharper toward margins; hinge of right valve consisting of 2 cardinals, the posterior (3*b*) larger and obscurely bifid, and an anterior and posterior lateral, the posterior somewhat obscured by the ligament; inner margin of the valve obscurely wrinkled; interior bearing obscure radial markings.

Length 14 mm.; height 13 mm.; diameter (right valve) 2.5 mm.

The holotype, a right valve, is the only specimen of this species. It is characterized by its strong sculpture and is similar to the living

West Indian species, *C. orbicularis* Linné, though smaller and more strongly sculptured.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352803).

Section JAGONIA Récluz.

Récluz, 1869, Actes de la Société Linnéenne de Bordeaux, vol. 27 (ser. 3, vol. 7,) p. 37.

Type (by original designation).—Le Jagon Adanson (=*Venus orbiculata* Montagu). Recent, west coast of Africa.

The following is a description of the section *Jagonia:*

Shell medium-sized, suborbicular, strongly inflated; lunule small, deeply depressed; sculpture consisting of narrow radial ribs and narrow concentric beads; ligament narrow; hinge resembling *Codakia* s. s., but the laterals are more systemmetrically situated with regard to the cardinals and the posterior laterals are stronger; inner margin of valve weakly frilled.

The living species of *Jagonia* are more widely distributed than *Codakia* s. s., and the Tertiary species have a correspondingly more extensive distribution in tropical, subtropical, and temperate faunas. Oligocene deposits of the Paris Basin carry the earliest European *Jagonia.* The earliest American species is of Miocene age.

Key to the Bowden species of Jagonia.

Shell strongly inflated, sculpture strong..... *C.* (*J.*) *vendryesi*
Shell moderately inflated, sculpture moderately strong..... *C.* (*J.*) *guppyi*

Codakia (Jagonia) vendryesi Dall.

(Plate 14, Figures 1 to 4.)

Codakia (*Jagonia*) *vendryesi* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1348, plate 52, fig. 4.

The following is the original description of this species:

This species is the Oligocene analogue of the recent *Lucina antillarum* Reeve (= *L. costata* Orbigny, not Tuomey and Holmes), from which it differs in its more inequilateral shell, sharper and more distinctly reticulate sculpture, with finer and more thread-like radials, plumper and usually smaller shell. It is abundant in the Bowden marl, from which it was collected by Henry Vendryes, esq., who sent it to Mr. Guppy, and subsequently by Messrs. Henderson and Simpson.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, inequilateral, lower part of anterior margin obliquely extended; umbos full, moderately prominent; lunule small, deep; dorsal area poorly defined except for the difference in sculpture; sculpture consisting of numerous fine, sharply defined radials, typically several fascicles, including usually 2, but sometimes 3 radials, extend from the umbo to the margin, and finer lower radials lie between the fascicles; the more prominent radials forming the fascicles on some shells become less prominent and almost equal to the others toward the margin; on some shells there are no fascicles, some

radials are merely more prominent than others or all are almost equal; radials bearing continuous rows of narrow prominent beads, continuing across interspaces and dorsal areas as concentric threads; anterior dorsal area bearing a few weak radials; anterior part of posterior dorsal area bearing no radials, remainder bearing a few radials that become weaker toward the margin, a very narrow area adjacent to the margin being almost or entirely smooth, but not depressed; cardinals and laterals strong; inner margin of valve finely fluted.

Length 8.2 mm.; height 9 mm.; diameter (right valve) 3 mm.

This species is the most abundant of the lucinoids, among which it is conspicuous, because of its sharply reticulate sculpture. The sculpture is very variable, presenting almost all gradations from fascicles of prominent radials, separated by finer ones, to virtually equal radials. On young shells that have fascicles the radials in the fascicles are fused for a considerable distance from the umbo and the finer intervening radials are more often absent than on adults. Some shells are more inflated than others. The largest valve has the following dimensions: length 9 mm.; height 9.1 mm.; diameter 2.9 mm.

Young valves on which the radials are almost equal may possibly be confused with certain shells of *Phacoides* (*Bellucina*) *actinus* Dall, which is less equilateral, and has fuller umbos, coarser and more regular radials, sharp, thin concentric lamellae, wider lunule, an escutcheon, weaker cardinals and more elongate laterals.

Lucina antillarum Gabb (not Reeve) from an unknown horizon in the Dominican Republic, which Dall placed in synonomy with *C. vendryesi,* has been described as *Phacoides perplexus* by Pilsbry and Johnson. It has a different hinge and different sculpture.

Type material.—3 cotypes (U. S. Nat. Mus. No. 135720).

Codakia (Jagonia) guppyi, new name.

(Plate 14, Figures 5 to 7.)

Lucina textilis Guppy, in Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 326, plate 30, fig. 1.

Codakia (*Jagonia*) *textilis* Guppy, Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1348.

Not *Lucina textilis* Philippi (= *Codakia* (*Jagonia*) *textilis*), 1850.

The following is the original description of this species:

Orbicular, occasionally a little irregular in outline; decussate by somewhat irregular fine radiating and concentric lines; margins dentate. Diameter, 11 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, thin, surface usually irregular, length exceeding height, slightly inequilateral, anterior end extended; umbo full, moderately high; lunule small, narrow, moderately depressed; anterior dorsal area poorly defined, posterior dorsal area depressed, on some valves causing a slight sinuation of the margin; sculpture consisting of numerous weak radials of irregular width, crossed by low, concentric threads of varying width and

irregularly spaced incrementals; on the dorsal areas the radials are absent or obscure; laterals of left valve weak; inner margin of valve finely fluted.
Length 14.2 mm.; height 12.5 mm.; diameter (right valve) 3.8 mm.

The concentric sculpture is irregular, as most of the valves are worn. It consists of irregularly spaced concentric threads of varying width and sharpness, which usually are absent on the median dorsal region, and of incrementals. Fine radials of varying width and prominence usually cover the entire shell, except in the umbonal region. Both sets of sculpture usually are conspicuous enough to produce a reticulate effect. The left laterals are much weaker than in the type of *Jagonia.*

The small size, slightly elongate outline, and fine radial sculpture are characteristic features.

Type material.—5 cotypes, the cotypes of *Lucina textilis* Guppy (U. S. Nat. Mus. No. 107103).

Genus LUCINA Lamarck.

Subgenus LUCINA s. s.

Lamarck, 1799, Mémoires de la Société d'Histoire Naturelle de Paris, p. 84.

Type (by monotypy).—Venus edentula Linné. Recent, Indo-Pacific.

The following is a description of the section *Lucina* s. s.:

Shell large, subspherical, thin; lunule small, depressed, escutcheon absent; sculpture consisting of exaggerated incrementals; ligament and resilium external, deeply inset; hinge edentulous; inner margin of valve smooth; anterior adductor scar long and narrow, paralleling the pallial line.

Tertiary and living species of *Lucina* s. s. are confined to American and Pacific waters. They are conspicuous in the Tertiary deposits of the Gulf States and the West Indies. European representatives belong to the subgenus *Loripinus,* which has no ligament, and an internal resilium.

Lucina (Lucina) bowdenensis, new species.

(Plate 14, Figures 8, 9.)

The following is a description of this species:

Shell medium-sized, thin, strongly inflated, suborbicular; anterior dorsal margin short, slightly excavated; upper part of anterior lateral margin obliquely truncate; posterior dorsal margin higher than anterior, longer and slightly convex; posterior lateral margin subtruncate at dorsal area; umbo broad, low; lunule very narrow, moderately depressed; anterior dorsal area poorly defined, posterior area more prominent; sculpture consisting of numerous fine, unequally spaced concentric threads, becoming more prominent and sublamellar on the posterior area; between the concentric threads over the entire surface of the shell are obscure wavy radial markings; hinge edentulous, hinge-plate of left valve swollen under umbo, simulating a cardinal; hinge of right valve having a corresponding subumbonal depression.

Length 24.5 mm.; height 22.2 mm.; diameter (left valve) 6.3 mm.

This species is known from 2 valves. It is more inequilateral and more inflated than *L. janus* Dall, a species from the Chipola formation of Florida, and *L. santarosana* Dall, a species from the Oak Grove sand of Florida. It more closely resembles *L. corpulenta* Dall, described from the Chipola formation of Florida, but has narrower umbos and a slightly depressed posterior dorsal area. The Bowden species is more inequilateral than the living West Indian species *L. chrysostoma* (Meuschen) and has a more depressed posterior dorsal area.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352805).

Genus MYRTAEA Turton.
Section MYRTAEA s. s.
Turton, 1822, Conchylia Insularum Britannicarum, p. 133.

Type (by monotypy).—*Venus spinifera* Montagu. Recent, seas of Europe.

The following is a description of the section *Myrtaea* s. s.:

Shell medium-sized, elongate ovate, subequilateral, moderately inflated; umbos low; lunule and escutcheon long, narrow, moderately depressed; sculpture consisting of concentric lamellae, prolonged on ridge at outer margin of escutcheon; ligament and resilium long, narrow; hinge of right valve consisting of a single cardinal (3), and strong anterior and posterior laterals; hinge of left valve consisting of a small anterior cardinal (2), a larger posterior cardinal (4*b*), and small anterior and posterior laterals.

In America, *Myrtaea* s. s. first appears in Eocene deposits, but in Europe no species are known before the Burdigalian. Living species inhabit tropical and temperate seas.

Myrtaea (Myrtaea) limoniana Dall.

(Plate 14, Figures 10 to 12.)

Myrtaea limoniana Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1358, plate 52, fig. 10. Olsson, Bull. Amer. Paleontology, vol. 9, p. 393, plate 35, figs. 11, 23, 1922.

The following is the original description of this species:

Shell small, thin, subequilateral, somewhat longer than high, only moderately convex, though hardly compressed; beaks small and low; lunule depressed, narrow, sublanceolate, small; surface covered with fine, sharp, thin, elevated, concentric lamellae, separated by wider interspaces and more elevated near the dorsal margins, especially behind the beaks, where in perfect specimens 5 or 6 of them are produced as small leaflets, which, however, are usually broken off; hinge with a single right and 2 left cardinal teeth, the laterals obsolete; scars normal; the margin of the valves entire. Alt. 8, lon. 9, diam. 4 mm.

Type locality.—Bowden, Jamaica.

The largest valve measures 11.9 mm. in length, 11 mm. in height and 2.2 mm. in diameter. Some of the valves are more inflated than others. The concentric sculpture varies from slightly elevated

lamellae to much more conspicuous lamellar fringes; much of this difference is, however, due to erosion. The lamellae are thin and closely spaced. Some valves from which the lamellae have been removed show microscopic vermiculations, like the camptonectes striation of certain Pectens, which brilliantly reflect light.

The shells from Limon, Costa Rica, are not quite so large as those from Bowden and the concentric lamellae are more closely spaced than on Bowden shells. Olsson records a specimen as large as Bowden shells from Red Cliff Creek, Costa Rica. Despite the name, the type of this species is from Bowden.

M. limoniana is larger than *M. lomasdesamba,* a species described by Maury from the Cercado formation of the Dominican Republic, and has coarser sculpture.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 157637).

Section MYRTEOPSIS Sacco.

Sacco, 1901, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, part 29, p. 96.

Type (by original designation).—Myrteopsis taurolaevis Sacco. Miocene, Italy.[1]

The following is a description of the section *Myrteopsis:*

Shell relatively large, elongate ovate, inequilateral, moderately inflated; umbos low; lunule long, narrow, slightly depressed; escutcheon absent; sculpture limited to irregularly emphasized incrementals; ligament and resilium long, narrow, deeply inset; hinge of right valve consisting of a single cardinal (3) and obscure anterior and posterior laterals; hinge of left valve consisting of a flattened anterior cardinal (2), a narrow posterior cardinal (4*b*), and hardly recognizable laterals.

Myrteopsis is larger than *Myrtaea* s. s., and has ruder sculpture and weaker laterals. *Codakia (Jagonia) pertenera* Dall seems to belong to this section. Its hinge is more like the hinge of *Myrtaea* than like the hinge of *Jagonia,* and externally the shell resembles *Myrteopsis magnotaurina* Sacco. If this Bowden species is correctly placed, it is the only known *Myrteopsis* aside from the Helvetian species from the Piedmont basin described by Sacco.

Myrtaea (Myrteopsis) pertenera (Dall).

(Plate 14, Figures 13 to 16.)

Codakia (Jagonia) pertenera Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1347, plate 51, fig. 4.

The following is the original description of this species:

Shell rather large, very thin, with the surface more or less irregularly indented, as if from nestling; anterior end larger, attenuated, posterior end

[1] I have not seen the type species. The description is based on the description and figures of *Myrteopsis magnotaurina* Sacco.

more plump, obscurely vertically truncate, beaks low; lunule long and very narrow, not deeply impressed; surface finely, closely, concentrically, and radially striated, but so feebly that no obvious cancellation results; hinge-margin narrow; hinge-teeth feeble, the laterals in the left valve obsolete or absent; scars lucinoid; margins sometimes obsoletely fluted. Height 32.5, length 35.0, diameter 13.5 mm.

Type locality.—Bowden, Jamaica.

This species has no escutcheon. The hinge of the right valve consists of a single flattened cardinal and weak anterior and posterior laterals. The hinge of the left valve consists of a small flattened anterior cardinal (2), a narrow posterior cardinal (4*b*), and mere traces of laterals. On young valves the sculpture is more distinct. Apparently no similar American species has been described.

Type material.—4 cotypes (U. S. Nat. Mus. No. 135716).

Section EULOPIA Dall.

Dall, 1901, Proceedings U. S. Nat. Mus., vol. 23, p. 804.

Type (by original designation).—Lucina sagrinata Dall. Recent, Gulf of Mexico.

The following is a description of the section *Eulopia:*

Shell small, rounded ovate, slightly inequilateral, strongly inflated; lunule and escutcheon very narrow, flattened; sculpture consisting of thin concentric lamellae and obscure vermicular radial threads between the lamellae; ligament and resilium external, deeply inset; hinge of right valve consisting of a large cardinal (3) and strong anterior and posterior laterals; hinge of left valve consisting of an anterior (2) and posterior (4*b*) cardinal and weak laterals; inner margin of valve smooth.

Aside from the difference in sculpture, *Eulopia* is separated from *Myrtaea* s. s. and *Myrteopsis* by the heavier right cardinal (3). *Eulopia* is an American group of Myrtaeas. The following Bowden species are the earliest species:

Key to the Bowden species of Eulopia.

Concentric lamellae closely spaced..... *M. (E.) vermiculata*
Concentric lamellae relatively distant..... *M. (E.) furcata*

Myrtaea (Eulopia) vermiculata Dall.

(Plate 15, Figures 1 to 3.)

Myrtaea (Eulopia) vermiculata Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1359, plate 52, fig. 5. ? Dall, 1915, Bull. U. S. Nat. Mus. No. 90, pp. 136-137, plate 23, fig. 14.

The following is the original description of this species:

Shell resembling *M. sagrinata* Dall, but shorter and more rounded; moderately convex, subequilateral, the anterior end slightly longer; beaks low and inconspicuous, lunule narrow, concavely excavated; the escutcheon linear, longer; both bounded externally by a serrate carina; ligamentary groove about half as long as the escutcheon; surface with slightly elevated, thin, concentric lamellae, the interspaces radially sculptured with close-set

vermiculate threads; hinge with the normal cardinal dentition and distinct right laterals; adductor scars rather small, the interpallial area punctate. Alt. 6.5, long. 7.5, diam. 3.5 mm.

Type locality.—Bowden, Jamaica.

The anterior and posterior dorsal margins are of virtually the same length. The anterior margin is moderately or strongly concave; the posterior is slightly convex and slopes more steeply.

The distinguishing features of this species are the relatively distant, sharply raised concentric lamellae and the irregular weak radials in the interspaces. Some of the valves are proportionally wider than the one figured by Dall. The principal difference between this species and *M. sagrinata* (Dall), a living West Indian species, is discussed by Dall.

The *Eulopia* from the Tampa formation of Florida that was referred to this species is no longer in the National Museum collections.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135717).

Myrtaea (Eulopia) furcata Dall.

(Plate 15, Figures 4, 5.)

Myrtaea (*Eulopia*) *furcata* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1359, plate 52, fig. 13.

The following is the original description of this species:

Shell thin, rounded, moderately convex, subequilateral; beaks low, inconspicuous; lunule long and narrow, moderately impressed, escutcheon almost linear, bordered outwardly by a carina; surface near the beaks with delicate, distant, slightly elevated concentric lines which become almost obsolete over the middle and basal portions of the disk; radial sculpture of fine, close-set, rather flattish threads, which towards the margins bifurcate and form a rather widely divaricate and somewhat irregular sculpture; hinge delicate, the right laterals feeble, ligamentary groove distinct, rather short; the adductor scars large, normal; the margins of the valves entire. Alt. 11.5, lon. 13, diam. 5 mm.

Type locality.—Bowden, Jamaica.

The shell is broader than high; the anterior dorsal margin concave, the posterior dorsal margin straight, longer, and more steeply sloping, so that the anterior lateral margin is more convex than the posterior.

This species is characterized by its delicate, widely spaced concentric sculpture, and weak numerous radials that are rather abruptly bent upward at the ends of the shell.

Type material.—2 cotypes (U. S. Nat. Mus. No. 135714).

Genus MILTHA H. and A. Adams.

Subgenus MILTHA s. s.

H. and A. Adams, 1857, The Genera of Recent Mollusca, vol. 2, p. 468.

Type (*by monotypy*).—*Lucina childreni* Gray. Recent, Coast of Brazil.

The following is a description of the subgenus *Miltha* s. s.:

Shell large, thick, ovate, compressed; umbos low, acute; lunule very small, deeply depressed; anterior and posterior dorsal areas poorly defined; sculpture consisting of exaggerated incrementals and obscure traces of radials; ligament and resilium external, wide, long; hinge of right valve consisting of a narrow anterior cardinal (3*a*) and a heavy obscurely bifid middle cardinal (3*b*); hinge of left valve consisting of a heavy obscurely bifid anterior cardinal (2) and a narrow posterior cardinal (4*b*); anterior adductor scar very long.

There are only four living species of *Miltha* s. s.; one on the coast of Brazil, two on the Pacific coast of Central America and Mexico, and one in the Indian Ocean. Its Tertiary distribution was more extensive. There are American Tertiary species beginning in the Eocene and several European species beginning in the Oligocene. No species are known in the Bowden formation.

Subgenus MEGAXINUS Brugnone.

Brugnone, 1880, Bulletino della Società Malacologica Italiana, vol. 6, p. 146.

Type (*by monotypy*).—*Lucina rostrata* Pecchioli (=*Lucina elliptica* Borson). Miocene and Pliocene, Italy.[1]

The following is a description of the subgenus *Megaxinus:*

Shell medium-sized, subovate, height exceeding length, or suborbicular, moderately inflated, inequilateral; umbos low; lunule small, deeply depressed; anterior and posterior dorsal areas poorly defined or absent; sculpture consisting of exaggerated incrementals; ligament seated on a slender nymph, dorsal margin of shell not abruptly indented at posterior end of nymph; hinge edentulous; anterior adductor scar moderately long.

The interior of most of the specimens of the Bowden species provisionally referred to this subgenus is inaccessible. It is more orbicular than the type, thus resembling *Miltha* (*Megaxinus*) *bellardiana* (Mayer) and *M.* (*M.*) *incrassata* (Dubois), Miocene species from southern Europe. There seems to be no generic difference between these species and the American later Tertiary and living species called *Pseudomiltha,* such as *"Pseudomiltha" anodonta* (Say). The type of *Pseudomiltha, P. gigantea* (Deshayes), an Eocene species from the Paris Basin, has a similar outline and edentulous hinge, but its wide, more exterior ligament is seated on a heavy nymph that abruptly ends at the posterior end of the ligament, leaving a notch in the dorsal margin of the shell as viewed from above.

Dall considered *Megaxinus* as similar to the genus *Thyasira* Lamarck. The type of *Thyasira, Lucina flexuosa* Montagu, has a small thin shell, wide shallow lunule, long narrow escutcheon, prominent posterior dorsal area, less deeply inset ligament, and a false tooth in front of the umbo, due to the indentation of the hinge margin.

[1] I have not seen the type species. The description is based on the description and figures of the type given by Sacco and on specimens of *Lucina incrassata subscopularum* d'Orbigny from Aquitaine.

Miltha (Megaxinus) gluminda, new species.

(Plate 15, Figure 6.)

The following is a description of this species:

Shell large, relatively thin, suborbicular, moderately inflated; dorsal margins subequal, diverging at an angle of about 120°, rounding into the lateral margins; umbo low, flat; sculpture consisting of exagerated incrementals; obscure radial threads are visible on worn parts of the shell; ligament long, deeply inset.

Length 42.5 mm.; height 42 mm.; diameter (right valve) 11 mm.

M. gluminda is described from several broken valves. A restored fragment has approximately the following dimensions: length 65 mm.; height 60 mm.; diameter (right valve) 15 mm.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352807).

Genus PHACOIDES Blainville.

Subgenus PHACOIDES s. s.

Blainville, 1825, Manuel de Malacologie et de Conchyliologie, p. 550.

Type (by monotypy).—Lucina jamaicensis Lamarck (=*Tellina pectinata* Gmelin). Recent, West Indies.

The following is a description of the subgenus *Phacoides* s. s.:

Shell large, suborbicular, moderately inflated; umbos low; lunule short, narrow, deeply depressed; anterior and posterior areas conspicuous; sculpture consisting of concentric lamellae and fine concentric threads; ligament and resilium external; hinge of right valve consisting of a heavy flattened middle cardinal (3*a*), a narrow obscure posterior cardinal (3*b*), and strong, thick anterior and posterior laterals; hinge of left valve consisting of narrow anterior (2) and posterior (4*b*) cardinals, and thick double laterals inclosing deep sockets; anterior adductor scar long, narrow, paralleling the pallial line; inner margin of valve smooth.

Species of *Phacoides* s. s. occur in the Tertiary deposits of Europe and America. They are found, like the living species, in both temperate and tropical faunas.

Phacoides (Phacoides ?) species.

(Plate 15, Figure 7.)

Phacoides domingensis Dall (part), 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1363, not plate 50, fig. 11.

The U. S. National Museum collection contains a fragment of the lower part of a right valve of a *Phacoides* that probably is a *Phacoides* s. s. The fragment shows part of the posterior dorsal area. The sculpture consists of closely spaced concentric lamellae and obscure secondary concentric threads.

The type of *Phacoides domingensis* is a shell collected from beds of unknown age on an island in Lago de Henriquillo, Dominican Republic. The broken Bowden valve has more closely spaced concentric lamellae and less distinct secondary concentric threads.

The species from the Tampa formation of Florida that has been called *P. domingensis* apparently is not a *Phacoides* s. s., as it has radial sculpture in addition to the concentric sculpture, and the right valve has double laterals.

Subgenus LINGA de Gregorio.

Section LINGA s. s.

de Gregorio, 1884, Bulletino della Società Malacologica Italiana, vol. 10, p. 217.

Type.—Lucina columbella Lamarck. Miocene, Touraine, France.

The following is a description of the section *Linga* s. s.:

Shell medium-sized, heavy, subspherical; lunule small, cordate, slightly depressed; anterior and posterior dorsal areas very prominent; sculpture consisting of concentric lamellae; ligament and resilium external; hinge of right valve consisting of a small anterior cardinal (3*a*), heavy obscurely bifid middle cardinal (3*b*), and heavy anterior and posterior laterals that are indented on the lower surface, the posterior lateral much farther from the cardinals than the anterior; hinge of left valve consisting of a heavy obscurely bifid anterior cardinal (2), a smaller posterior cardinal (4*b*), and thick double laterals inclosing deep sockets, the lower lamellae fitting into the indentations on the lower surface of the right laterals; anterior adductor scar long and narrow, paralleling the pallial line; inner margin of valve obscurely wrinkled.

West Indian and eastern American Tertiary and living species of *Linga* have been placed in the subgenus *Here* Gabb. The type of *Here, Lucina* (*Here*) *richthofeni* Gabb, was described from beds of Pliocene age in southern California. It has a very obscure anterior dorsal area and an extraordinarily deep lunule that almost completely effaces the anterior cardinal on both valves. The upper laterals on the left valve are heavy and the lower surface of the right laterals are only slightly indented. No species similar to *Phacoides* (*Here*) *richthofeni* is known from the east coast of America or the West Indies.

The earliest *Linga* is a species from American middle Eocene deposits (Claiborne group). *Linga* is particularly abundant in the tropical and subtropical late Tertiary faunas of Florida and the West Indies and is still living in the same regions. During late Miocene time it extended as far north as North Carolina, where, in company with many other tropical genera, it is found in the warm temperate fauna of the Duplin marl. The earliest European species is of Aquitanian age. Like many other tropical genera that lived in European seas during Miocene time, it has withdrawn to tropical west African waters.

Key to the Bowden species of Linga.

Length of adult shell exceeding 8 mm., concentric lamellae not elevated.
  Shell strongly inflated..... *P.* (*L.*) *podagrinus podagrinus*
  Shell moderately inflated.
    Posterior margin rounded..... *P.* (*L.*) *podagrinus alarantus*
    Posterior margin subangular..... *P.* (*L.*) *browni*
Length of adult shell not exceeding 8 mm., concentric lamellae elevated.. *P.* (*L.*) *tithonis*

Phacoides (Linga) podagrinus podagrinus Dall.

(Plate 15, Figures 8 to 11.)

Lucina pennsylvanica Guppy (not Linné), Quart. Jour. Geol. Soc. London, vol. 22, p. 292. Guppy (part, not Linné), 1874, Geol. Mag., decade 2, vol. 1, p. 442, (list).

Phacoides (*Here*) *podagrinus* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1365-1366, plate 50, figs. 12, 13.

The following is the original description of this subspecies:

Shell when young moderately convex, when senile having an exaggerated thickness and almost spherical convexity. It belongs to the group of *P. pennsylvanicus* L., of which species it is doubtless a precursor, and the mention of that species by Gabb and Guppy in the "Miocene" (Oligocene) of St. Domingo and Jamaica doubtless refers to the present fossil. For this reason it is best described by comparison with *P. pennsylvanicus*, from which it differs by its smaller size and greater inflation at maturity, its finer and closer concentric sculpture, its shorter and broader posterior dorsal area, its less elevated beaks, its slightly smaller and more distinctly limited anterior dorsal area, and its more nearly circular outline. Alt. 28, lon. 28, diam. 30 mm. The largest specimen observed has a length of 42 and a diameter of 35 mm., while a specimen of *P. pennsylvanicus* of the same size has a diameter of only 25.

Type locality.—Bowden, Jamaica.

Although this species is represented by a large number of shells, there is a sharp break between the few excessively inflated largest shells and the smaller less inflated shells. The largest of the normal shells has the following dimensions: length 28 mm.; height 28 mm.; diameter (right valve) 10 mm. The smallest of the greatly inflated shells has the following dimensions: length 32 mm., height 33.5 mm., diameter (right valve) 15 mm. Dall figured one of the greatly inflated shells. Young shells have higher umbos than adults. The strong inflation of even normal shells and the rather fine concentric lamellae are the characteristic features of this species. The species from the Tampa formation of Florida, *P. wacissanus* Dall, is smaller, less inflated and has a steeper and longer anterior dorsal margin. *P. glenni* Dall, described from the Chipola formation of Florida, is less inflated, and has smaller umbos and coarser concentric sculpture. *P. densatus* (Conrad), a species from the Duplin marl of North Carolina, also is less inflated, larger and has lower umbos than normal Bowden shells.

A similar undescribed species was collected from the Cercado formation in the Dominican Republic.

Type material.—7 cotypes (U. S. Nat. Mus. No. 135710).

Phacoides (Linga) podagrinus alarantus, new subspecies.

(Plate 15, Figure 12.)

The following is a description of this subspecies:

Shell medium-sized, suborbicular, moderately inflated; dorsal areas conspicuous; lunule small, hardly differentiated from the anterior dorsal area;

umbos moderately inflated; sculpture consisting of closely spaced concentric lamellae.

Length 26.5 mm.; height 27.5 mm.; diameter (right valve) 8 mm.

This subspecies is much less inflated than *P. podagrinus prodagrinus,* and has a slightly wider anterior dorsal area.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352808).

Phacoides (Linga) browni, new species.

(Plate 16, Figure 1.)

The following is a description of this species:

Shell medium-sized, moderately inflated, suborbicular; posterior dorsal margin long and only slightly curved; posterior lateral margin obscurely truncated; anterior dorsal margin sloping very gently; umbos low; posterior dorsal area wide, not deeply depressed; anterior dorsal area sharply depressed; sculpture consisting of prominent, evenly spaced concentric lamellae over the entire surface of the shell.

Length 37 mm.; height 35.5 mm.; diameter (left valve) 9.5 mm.

P. browni is characterized by its gently curved posterior dorsal margin, low umbo, and prominent uniform concentric sculpture. It is less inflated than *P. podagrinus* and has a more angular posterior margin. It more closely resembles the living West Indian species *P. pennsylvanicus* (Linné), but is less inflated, less orbicular, and has a shorter anterior dorsal margin and finer sculpture.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352809).

Phacoides (Linga) tithonis Dall.

(Plate 16, Figures 2, 3.)

Phacoides (*Here*) *tithonis* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1366-1367, plate 50, fig. 10.

The following is the original description of this species:

Shell small, rotund, with rather prominent beaks, the dorsal areas not distinguished by sculpture and indicated only by faint, broad, radial sulci; lunule small and deep, no escutcheon visible; surface with profuse, elevated, rather unevenly spaced, concentric lamellae; hinge well developed; margins minutely crenulated. Alt. 3.0, lon. 4.5, diam. 3.8 mm.

Type locality.—Bowden, Jamaica.

The hinge of this species resembles the hinge of the type of *Linga,* but the dorsal areas are not depressed and the concentric lamellae are thinner and more elevated. It resembles, as Dall pointed out, the living West Indian *P. sombrerensis* Dall.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135723).

Section PLEUROLUCINA Dall.

Dall, 1901, Proceedings U. S. Nat. Mus., vol. 23, p. 805.

Type (*by original designation*).—*Lucina leucocyma* Dall. Recent, West Indies.

The following is a description of the section *Pleurolucina:*

Shell small, higher than wide, strongly inflated; umbos high, strongly twisted; lunule small, hardly differentiated; anterior and posterior dorsal areas prominent, elevated near margin of shell; sculpture consisting of concentric lamellae and 3 radial grooves; ligament and resilium external, short; hinge of right valve consisting of a small anterior cardinal (3*a*), a heavy obsurely bifid middle cardinal (3*b*), and strong anterior and posterior laterals, their lower surface indented; hinge of left valve consisting of an obscurely bifid anterior cardinal (2), a posterior cardinal (4*b*), and heavy double laterals, the lower laterals larger than the upper; inner margin of valve minutely fluted.

The difference in outline and sculpture separate the small species of this section from *Linga* s. s. The lucinoid described by Sacco as *Here miobarbieri,* from the Helvetian of the Piedmont basin, probably is a *Pleurolucina.* If so, it is the only European representative of this tropical American group. The following Bowden species is the earliest American species.

Phacoides (Pleurolucina) quadricostatus Dall.

(Plate 16, Figures 4 to 6.)

Phacoides (*Pleurolucina*) *quadricostatus* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1368, plate 50, fig. 7.

The following is the original description of this species:

Shell small, plump, oblique, high, short, with strongly impressed large dorsal areas; beaks small, prosogyrate, overhanging a very small cavernous lunule; ligament short; surface densely covered with high, concentric lamellae with slightly wider interspaces, the distal edges of the lamellae wider and reflexed dorsally; radial sculpture of 4 rapidly distally widening broad ribs separated by narrow sulci, the 2 inner ribs wider than the outer pair; hinge normal, strong; scars normal; inner margins of the valves crenate. Alt. 9, lon. 6, diam. 7 mm.

Type locality.—Bowden, Jamaica.

P. quadricostatus, the Pliocene species *P. amabilis* Dall and the living West Indian species *P. leucocyma* Dall are very similar. The Pliocene species is larger than *P. quadricostatus* and has finer and less lamellar sculpture. *P. leucocyma* has less sharply defined radial grooves and less lamellar concentric sculpture.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135722).

Subgenus CARDIOLUCINA Sacco.

Sacco, 1901, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, part 29, p. 89.

Type (*by original designation*).—*Cardium agassizii* Michelotti. Miocene, Italy.[1]

The following is a description of the subgenus *Cardiolucina:*

Shell small, strongly inflated, strongly inequilateral, anterior end extended; lunule small, deeply depressed; anterior and posterior dorsal areas

[1]I have not seen the type species. The description is based on the description and figures given by Sacco.

slightly depressed; sculpture consisting of concentric lamellae frilled by obscure threads; ligament and resilium external; hinge of right valve consisting of a very small anterior cardinal (3*a*), a heavier middle cardinal (3*b*), and strong anterior and posterior laterals; hinge of left valve consisting of an anterior cardinal (2), a smaller posterior cardinal (4*b*), and double anterior and posterior laterals, the lower laterals stronger than the upper; inner margin of valve minutely frilled.

The American Tertiary and living species of *Cardiolucina* have been placed in the subgenus *Cavilucina* Fischer. The type of *Cavilucina, Lucina salcata* Lamarck, described from Eocene beds in the Paris Basin, has very obscure cardinals and laterals.

Cossmann suggested that the Eocene species *Lucina barbieri* Deshayes probably is a *Cardiolucina.* The oldest American species are of lower Miocene (Burdigalian) age. There are many species in the Miocene and Pliocene tropical and subtropical American faunas. The group is now living in West Indian waters, but has completely disappeared in European waters.

Phacoides (Cardiolucina) recurrens Dall.

(Plate 16, Figures 7, 8.)

Phacoides (*Cavilucina*) *recurrens* Dall (part), 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1369, plate 52, fig. 11. Dall (part), 1915, Bull. U. S. Nat. Mus., No. 90, p. 138, plate 24, fig. 3.

The following is the original description of this species:

Shell small, flattish or only moderately convex, oblique, inequilateral, the dorsal areas hardly indicated; beaks small, low, prosogyrate over a small, moderately impressed rather narrow lunule; posterior dorsal margin convexly arched, as high as the beaks; surface finely, concentrically rather closely grooved, with, toward the base, 2 or 3 deep, concentric sulci indicating resting stages; hinge-teeth small but distinct; inner margins of the valves minutely crenulated. Alt. 6.5, lon. 5.7, diam. 4.0 mm.

Type locality.—Bowden, Jamaica.

This species is conspicuous for its small size, very inequilateral outline and prominent umbos. The fine concentric sculpture is obscure or entirely absent on many shells and the surface is almost smooth except for the deep irregularly spaced grooves.

No specimens of this species from the Tampa formation of Florida are in the U. S. National Museum collection at the present time. The shell figured in Bulletin 90 of the U. S. National Museum is the type, a Bowden shell. Specimens from the Chipola formation of Florida formerly called *P. recurrens* have been referred by Gardner to *P. trisculcatus* (Conrad), a Duplin marl species that has wider and fuller umbos and a larger lunule.

Similar small *Cardiolucinas* are common in the Miocene and Pliocene deposits of Florida and the middle Atlantic states. Such species include *P. trisulcatus* (Conrad), *P. multistriatus* (Conrad), *P. whit-*

fieldi Dall, and the living *P. blandus* Dall. None of the American species have the radial sculpture of the type species, but they have a minutely frilled inner margin and the same type of hinge.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135721).

Subgenus CALLUCINA Dall.

Dall, 1901, Proceedings U. S. Nat. Mus., vol. 23, p. 806.

Type (by original designation).—*Lucina radians* Conrad. Miocene and Pliocene, middle Atlantic States.

The following is a description of the subgenus *Callucina:*

Shell medium-sized, suborbicular, moderately inflated; lunule larger on left valve than on right; dorsal areas absent; sculpture consisting of concentric lamellae and obscure radial threads; ligament and resilium external; hinge of right valve consisting of a bifid midle cardinal (3), and obscure traces of laterals; hinge of left valve consisting of anterior (2) and posterior (4*b*) cardinals, and obscure traces of laterals; inner margin of valve finely fluted.

Callucina resembles *Cavilucina* Fischer, but has stronger cardinals. All the Tertiary and living species of *Callucina* are American. They first appear in middle Miocene deposits and are characteristic of tropical and subtropical faunas.

Key to the Bowden species of Callucina.

Radial sculpture obscure, length of adult shell exceeding 10 mm.... *P. (C.) pauperatus*
Concentric sculpture consisting of fine lamellae.... *P. (C.) pauperatus pauperatus*
Concentric sculpture consisting of relatively coarse lamellae.
P. (C.) pauperatus oligocostatus
Radial sculpture relatively strong, length of adult shell not exceeding 10 mm..... *P. (C.) eurycostatus*

Phacoides (Callucina) pauperatus pauperatus (Guppy).

(Plate 16, Figures 9 to 13.)

Lucina pauperata Guppy, in Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 326, plate 30 fig. 3.
Phacoides (Callucina) pauperatus (Guppy), Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1380.

The following is the original description of this subspecies:

Suborbicular, not very convex, with faint, broad radiating (ray-like) grooves and sublamellar concentric ridges. Diameter, 11.5 mm. The radiating ornament looks like color, but it is really faint, shallow flutings.

Type locality.—Jamaica.

The following supplements the original description of this subspecies:

Shell medium-sized, moderately inflated, suborbicular, anterior end slightly more extended; posterior margin almost vertically subtruncate; umbos full, low; anterior and posterior dorsal areas poorly defined; lunule narrow, shallow, of variable length, absent or poorly developed on some left valves; sculpture consisting of fine, closely spaced concentric lamellae,

which are sharp-edged toward the margins and on many adult shells are absent on the upper median part of shell; very obscure radial threads and wider depressions of varying width radiate from the umbo; inner margin of the valve finely fluted.

Length 16.5 mm.; height 16.5 mm.; diameter (right valve) 3.8 mm.

This is one of the most abundant Lucinoid. The largest valve has the following dimensions: length 18.5 mm.; height 18 mm.; diameter 4.6 mm. The radials are weak, but on some shells undulate the concentric lamellae. In addition to these relatively coarse radials, very fine and obscure radials may cover the median part of adult shells.

Young valves that have obscure radials and strong concentric sculpture may be confused with specimens of *Myrtaea limoniana* of the same size and this resemblance is augmented by the similarity of the hinge. *P. pauperatus* is slightly more convex, and has more prominent umbos and a stronger hinge. The fluting of the inner margin of *P. pauperatus,* which on most young valves is more prominent than on adults, is an infallible guide.

P. radians (Conrad), which ranges from the Duplin marl (upper Miocene) to the Recent, closely resembles the Bowden species, but is slightly more inflated, and has higher, narrower, and more strongly twisted umbos, stronger sculpture, and heavier hinge. Olsson has described a small Miocene subspecies, *P. radians medioamericanus* from Costa Rica.

Type material.—2 cotypes (U. S. Nat. Mus. No. 107101).

Phacoides (Callucina) pauperatus oligocostatus, new subspecies.

(Plate 16, Figures 14, 15.)

The following is a description of this subspecies:

Shell medium-sized, suborbicular, strongly inflated; umbos full, relatively high; dorsal area not differentiated; concentric sculpture consisting of coarse, strong lamellae; radial sculpture consisting of very obscure threads.

Length 17.8 mm.; height 16.8 mm.; diameter (right valve) 4.5 mm.

This subspecies is more orbicular and more inflated than *P. pauperatus pauperatus* and has more obscure dorsal areas and coarser, more persistent concentric sculpture. Externally, it resembles *Phacoides perplexus* Pilsbry and Johnson, a Miocene species from the Dominican Republic, but has narrower ribs on the umbo; it also has more slender cardinals on the left valve.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352810).

Phacoides (Callucina) eurycostatus, new species.

(Plate 16, Figures 16, 17.)

The following is a description of this species:

Shell small, inflated, suborbicular; anterior dorsal margin short, deeply excavated; posterior margin subtruncate; umbo full, narrow, relatively high; lunule cordate, deeply depressed; dorsal areas obscure; sculpture

consisting of relatively broad obscure radials, and fine, closely and evenly spaced, low concentric lamellae, poorly defined in the median dorsal region; inner margin of valve bearing obsure, fine flutings and broader undulations that conform to the external radials; right valve not known.

Length 8 mm.; height 7.5 mm.; diameter (left valve) 1.8 mm.

This species is known only from the holotype, a left valve. It is distinguished from young shells of *P. pauperatus* by its greater inflation, deeper lunule, and much broader, more pronounced radials.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352811).

Subgenus PARVILUCINA Dall.

Section PARVILUCINA s. s.

Dall, 1901, Proceedings U. S. Nat. Mus., vol. 23, p. 806.

Type (*by original designation*).—*Lucina tenuisculpta* Carpenter. Recent, west coast of United States.

The following is a description of the section *Parvilucina* s. s.:

Shell small, suborbicular, slightly inequilateral; lunule small, deeply depressed; dorsal areas absent; sculpture consisting of concentric lamellae and low radial threads; ligament and resilium external; hinge of right valve consisting of an obscurely bifid middle cardinal (3) and strong laterals; hinge of left valve consisting of anterior (2) and posterior (4*b*) cardinals and double laterals; inner margin of valve minutely fluted.

Parvilucina is separated from *Callucina* by the strong laterals and stronger sculpture. It resembles *Cardiolucina,* but has no right anterior cardinal. It is another American group of small *Phacoides* first appearing in middle Eocene deposits. Species have been described from the temperate Miocene faunas of the Atlantic states, as well as from the southern tropical and subtropical faunas.

Key to the Bowden species of Parvilucina s. s.

Shell moderately inflated, radial sculpture weak.....*P.* (*P.*) *yaquensis morantensis*
Shell strongly inflated, radial sculpture relatively strong..... *P.* (*P.*) *limnidus*

Phacoides (Parvilucina) yaquensis morantensis, new subspecies.

(Plate 17, Figures 1, 2.)

Phacoides (*Parvilucina*) *yaquensis* Dall (part, not Gabb), 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1382.

The following is a description of this subspecies:

Shell small, subequilateral, moderately inflated; anterior dorsal margin excavated; posterior dorsal margin almost straight, sloping, meeting lateral margin at a subrounded angle; anterior lateral margin longer and less curved than posterior; base sloping toward anterior end; umbos relatively prominent; lunule small, cordate, moderately depressed; sculpture consisting of closely spaced, thin, concentric lamellae and narrow obscure radials, separated by narrower interspaces; on some shells the radials are strong enough to slightly wrinkle the lamellae; radials absent on the dorsal areas; hinge normal, laterals, especially the posterior, elongate; inner margin of valve finely and weakly fluted.

Length 5.0 mm.; height 4.5 mm.; diameter (right valve) 1.2 mm.

This subspecies closely resembles *P. yaquensis yaquensis* Gabb, which is the most common Lucinoid in the Cercado formation of the Dominican Republic but is slightly larger, and has more distinct radial sculpture, and deeper lunule. The most striking difference is the heavier hinge of the Bowden subspecies.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352812).

Phacoides (Parvilucina) limnidus, new species.

(Plate 17, Figures 3, 4.)

The following is a description of this species:

Shell small, suborbicular, strongly inflated; anterior margin more evenly rounded than posterior; umbo full, high, broad; lunule relatively large, deeply depressed; dorsal areas poorly defined; sculpture consisting of low narrow radials, crossed by concentric wrinkles and low lamellae; hinge of right valve consisting of a heavy, strongly oblique middle cardinal (3) and anterior and posterior laterals; inner margin of valve weakly fluted; left valve not known.

Length 5.5 mm.; height 5.5 mm.; diameter (right valve) 2 mm.

This species is described from one right valve. It is more strongly inflated than *P. yaquensis morantensis* and has cruder sculpture, recalling *Codakia (Jagonia) guppyi.*

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352813).

Section BELLUCINA Dall.

Dall, 1901, Proceedings U. S. Nat. Mus., vol. 23, p. 806.

Type (by original designation).—Parvilucina eucosmia Dall (=*Lucina pisum* Reeve 1850, not Sowerby, 1837). Recent, Indo-Pacific.[1]

The following is a description of the section *Bellucina:*

Shell small, suborbuicular; lunule moderately small, moderately depressed; posterior dorsal area strongly defined; sculpture consisting of strong radials and strong concentric lamellae; hinge resembling *Parvilucina* s. s.; inner margin of valve finely fluted.

The stronger sculpture and stronger posterior dorsal area separate *Bellucina* from *Parvilucina* s. s. *Bellucina* comprises several American and Pacific species. The following Bowden species is the earliest species.

Phacoides (Bellucina) actinus Dall.

(Plate 17, Figures 5 to 8.)

Phacoides (Bellucina) actinus Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1385, plate 52, fig. 3. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 370. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 396, plate 35, fig. 24.

[1] I have not seen the type species. The description is based on Dall's description and on figures of *Lucina pisum* given by Reeve.

The following is the original description of this species:

Shell small, plump, somewhat inequilateral, with moderately prominent, slightly decurved beaks; anterior end larger and more inflated; lunule lanceolate, somewhat longer and narrower in the right valve, distinctly impressed; escutcheon impressed, almost linear; disk with 16 to 18 rounded radial ribs, entire and wider towards the base, with narrower deep interspaces; concentric sculpture of thin lamellae, with much wider interspaces, which are somewhat crenulated or waved by overriding the ribs and dipping into the radial interspaces; dorsal areas large, slightly impressed, with no radial sculpture, the concentric lamellae on the posterior area close-set, low, but on the bounding rib and on a radial line near the dorsal margin slightly elevated; hinge normal, delicate, internal margins minutely crenulate. Alt. 4.5, lon. 4.6, diam. 3.0 mm.

Type locality.—Bowden, Jamaica.

The small valves of this species are very abundant. The number of radial ribs may be as high as 22. The escutcheon is not so deeply depressed as the lunule and the posterior dorsal area is more conspicuous than the anterior. Some of the valves are much more inflated than others. The radial or concentric sculpture, or both, may be weak. Valves sculptured with suppressed radials closely resemble *P. yaquensis morantensis,* from which they may be distinguished by their coarser concentric sculpture, more pronounced posterior dorsal area, more deeply depressed lunule, slightly heavier hinge, and deeper and coarser internal fluting.

Maury has described the same or a similar species from the Cercado formation of the Dominican Republic. Olsson has described small specimens from Bocas Island, Panama.

Other localities.—? Cercado formation (lower Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama.

Type material.—5 cotypes (U. S. Nat. Mus. No. 135719).

Genus DAVARICELLA von Martens.

Section DIVARICELLA s. s.

von Martens, 1880, Beiträge zur Meersfauna der Insel Mauritius und der Seychellen, p. 321.

Type (by monotypy).—Lucina (Divaricella) angulifera von Martens (=*Lucina ornata* Reeve). Recent, Indo-Pacific.[1]

The following is a description of the section *Divaricella* s. s.:

Shell medium-sized, orbicular, strongly inflated; umbos low; lunule small, moderately deep; sculpture consisting of oblique grooves angulated along a line extending obliquely downward and forward from the umbo; ligament and resilium united, deeply inset; hinge of right valve consisting of a narrow anterior cardinal (3*a*), a heavy middle cardinal (3*b*), and an anterior and posterior lateral; hinge of left valve consisting of a heavy anterior cardinal (2), a narrow posterior cardinal (4*b*), and double anterior and posterior laterals; posterior laterals much farther from cardinals than

[1] I have not seen the type species.

anterior; inner margin of valve finely fluted; anterior adductor scar long and narrow, paralleling pallial line.

Tertiary and living species of *Divaricella* have a wide distribution.

Divaricella (Divaricella) prevaricata Guppy.

(Plate 17, Figures 9 to 13.)

Divaricella prevaricata Guppy, in Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 327, plate 30, fig. 4. Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1389. ? Maury, 1920, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 1, p. 34, New York Acad. Sci. ? Hubbard, 1921, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 2, p. 113, New York Acad. Sci. Not Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 371, plate 61, fig. 10. (= *D. proletaria* Pilsbry and Johnson).

The following is the original description of this species:

Suborbicular, inflated, margins minutely denticulate, surface divaricately sculptured. Length of shell, 8 mm.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell medium-sized, thin, suborbicular, moderately inflated; posterior dorsal margin slightly longer and straighter than anterior; umbos full, relatively prominent; lunule small, slightly depressed, almost or entirely confined to right valve; sculpture relatively fine; incrementals irregularly spaced and unequally emphasized; right posterior cardinal of some valves obscurely bifid; posterior and anterior laterals strong; inner dorsal margin slightly serrated by the sculpture, remainder of margin non-serrate, but finely fluted on its inner edge.

Length 12.5 mm.; height 12.1 mm.; diameter (left valve) 3.9 mm.

A few valves have slightly coarser sculpture than the holotype. It is difficult to separate some of the valves from immature valves of the living West Indian species *D. quadrisulcata* (d'Orbigny), but the right and left anterior cardinals of the Bowden species are heavier. The species described by Maury from the Cercado formation of the Dominican Republic as *D. "prevaricata"* is *D. proletaria.* The Bowden species has heavier anterior cardinals, finer sculpture, and lower and less inflated umbos. External casts of a *Divaricella* from the Quebradillas limestone (lower Miocene) of Porto Rico were called *D. prevaricata* by Maury and Hubbard.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 107102).

Family DIPLODONTIDAE.

Genus DIPLODONTA Bronn.

Section DIPLODONTA s. s.

Bronn, 1831, Italiens Tertiär-Gebilde und deren organisch Einschlüsse, p. XII.

Type (by subsequent designation, Gray 1847).—Venus lupina Brocchi (=*Tellina rotundata* Montagu). Miocene and Pliocene, Italy.

The following is a description of the section *Diplodonta* s. s.:

Shell medium-sized, suborbicular; sculpture consisting of incrementals; ligament external; hinge of right valve consisting of a heavy anterior cardinal (3*a*) and a heavy, deeply bifid middle cardinal (3*b*); hinge of left valve consisting of a heavy deeply bifid anterior cardinal (2) and a narrow posterior cardinal (4*b*); anterior adductor scar longer and narrower than posterior.

Species of *Diplodonta* s. s. were widely distributed in the Tertiary seas and their present distribution is extensive.

The Bowden species are much smaller than the type species.

Key to the Bowden species of Diplodonta s. s.

Shell suborbicular, strongly inflated..... *D.* (*D.*) *walli*
Shell trigonal, moderately inflated..... *D.* (*D.*) *homalostriata*

Diplodonta (Diplodonta) walli, new species.

(Plate 17, Figures 14, 15.)

The following is a description of this species:

Shell small, suborbicular, strongly inflated; anterior margin slightly more extended than posterior; umbos full, broad, high; sculpture limited to irregularly spaced, obscure incrementals; hinge of right valve consisting of 2 subequal cardinals, the posterior one (3*b*) obscurely bifid; hinge of left valve consisting of a long, bifid anterior cardinal (2) and a narrow posterior cardinal (4*b*); ligament short.

Length 6.5 mm.; height 6.5 mm.; diameter (right valve) 2.5 mm.

D. walli, which is represented by 2 valves, externally resembles *D. capuloides* (Gabb), a species confined to the Cercado formation of the Dominican Republic, but is larger and has a heavier hinge; its right anterior cardinal (3*a*) is simple, not composed of two parts. *D. capuloides* apparently is not a *Diplodonta* s. s., but is not a *Sphaerella,* as Pilsbry has suggested.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352815).

Diplodonta (Diplodonta) homalostriata, new species.

(Plate 17, Figures 16, 17.)

The following is a description of this species:

Shell small, trigonal suborbicular, moderately inflated, anterior end slightly more extended than posterior; umbos low, narrow; sculpture consisting of fine, obscure concentric rugae; ligament short; hinge of right valve consisting of a narrow anterior cardinal (3*a*), and a heavy bifid posterior cardinal (3*b*); hinge of left valve consisting of a heavy bifid anterior cardinal (2) and a narrow posterior cardinal (4*b*).

Length 6.2 mm.; height 6.2 mm.; diameter (right valve) 1.5 mm.

This species closely resembles *D. collina* Olsson,[1] described from Miocene beds in Costa Rica, but is slightly less inflated and less inequilateral and has wider umbos.

[1] Comparison based on figures.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352816).

Section FELANIELLA Dall.

Dall, 1899, Journal of Conchology, vol. 9, p. 244.

Type (by original designation).—Felania usta Gould. Recent, Japan.[1]

The following is a description of the section *Felaniella:*

Shell small, very inequilateral, slightly inflated; sculpture consisting of incrementals; ligament external; hinge of right valve consisting of a narrow anterior cardinal (3*a*) and a heavy, deeply bifid middle cardinal (3*b*); hinge of left valve consisting of a heavy, deeply bifid anterior cardinal (2) and a narrow posterior cardinal (4*b*).

The shell is more compressed and more inequilateral than in *Diplodonta* s. s. *Felaniella* first appears in Eocene deposits in America and Europe. Although Miocene species are recorded from southern Europe, the living species seem to be confined to West Indian and Pacific waters.

Diplodonta (Felaniella) minor Dall.

(Plate 17, Figures 18 to 21.)

Diplodonta (Felaniella) minor Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1183, plate 44, fig. 17.

The following is the original description of this species:

Shell small, moderately convex, smooth, polished, oblique, inequilateral, the lower anterior side produced, the posterior side shorter, rounded; margins simple, pallial line and adductor scars normal, the right anterior cardinal submarginal, rather long; the posterior cardinal short, vertical, deeply bifid, the beaks low and pointed, both the left anterior cardinals short, the anterior bifid. Alt. 4.5, lat. 3.8, diam. 2.5 mm.

Type locality.—Bowden, Jamaica.

The surface may bear obscure concentric striae. This species resembles the Miocene Dominican species *D. dedecoris* Pilsbry and Johnson and *D. insula* Olsson, a Miocene species from Panama, but is more oblique.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135724).

Section PHYLCTIDERMA Dall.

Dall, 1899, Journal of Conchology, vol. 9, p. 244.

Type (by original designation).—Diplodonta semiaspera Philippi. Recent, West Indies.

The following is a description of the section *Phlyctiderma:*

Shell small, suborbicular, strongly inflated; sculpture consisting of incrementals and minute pustules; ligament and resilium external; hinge of right valve consisting of a relatively heavy anterior cardinal (3*a*), and a

[1] I have not seen the type species.

heavy, oblique, bifid posterior cardinal (3*b*); hinge of left valve consisting of a heavy bifid anterior cardinal (2), and a narrow, elongate posterior cardinal (4*b*).

The pustular sculpture is the most striking feature of this section, which is an American and Pacific group of Diplodontas, first appearing in Miocene time.

Diplodonta (Plyctiderma) gabbi Dall.

(Plate 18, Figures 1 to 3.)

Mysia subquadrata Gabb, 1873, Trans. Amer. Philos. Soc., n. s. vol. 15, p. 252. Not *Diplodonta subquadrata* Carpenter, 1855.

D. (*iplodonta*) *gabbi* Dall, 1900, Trans. Wagner Fee Inst. Sci. Philadelphia, vol. 3, part 5, p. 1183, footnote.

Diplodonta (*Phlyctiderma*) *puncturella* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1183, plate 45, fig. 26. Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, part 1, p. 495. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 371. Not Dall, 1915, Bull. U. S. Nat. Mus., No. 90, p. 140.

Diplodonta (*Phlyctiderma*) *gabbi* Dall, Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 418, text-fig. 43.

The following is the original description of *Mysia subquadrata* Gabb:

Shell small, thin, moderately convex; outline rounded sub-quadrate, length and width about equal, beaks small, prominent, hinge-line sloping equally on both sides. Surface smooth.

Type locality.—Dominican Republic.

The following description is quoted from Pilsbry:

Externally, this species has an extremely minute, irregular but dense punctuation. The largest valve (figured) measures, length 5.6, alt. 5.4, diam. 1.65 mm.

The following is the original description of *D. puncturella* Dall:

Shell small, thin, rounded, moderately convex, with inconspicuous beaks, outline nearly circular, the beaks smooth, but the rest of the external surface closely minutely punctate all over, other characters as in typical *Diplodonta,* like *D. capuloides,* but less turgid. Alt. 6.7, lat. 6.5, diam. 4 mm.

Type locality.—Bowden, Jamaica.

The incrementals are stronger near the margin of the shell than elsewhere. In the Dominican Republic this species apparently is confined to the Cercado formation. Specimens from Bowden are slightly larger. Recent shells from Porto Rico, St. Thomas, and Jamaica apparently represent the same species, but are not quite so strongly inflated.

Other localities.—Cercado formation (lower Miocene), Dominican Republic. Living, West Indies.

Type material.—Holotype (right valve, Acad. Nat. Sci. Philadelphia, No. 2693).

Superfamily ERYCINACEA.

Family ERYCINIDAE.

Genus ERYCINA Lamarck.

Subgenus ERYCINA s. s.

Lamarck, 1805, Annales du Museum d'Histoire Naturelle, vol. 6, p. 413.

Type (by subsequent designation, Gray 1847).—Erycina pellucida Lamarck. Eocene, Paris Basin.

The following is a description of the subgenus *Erycina* s. s.:

Shell small, elliptical, subequilateral or inequilateral, slightly inflated; umbos low; sculpture consisting of incrementals; resilium seated on a small oblique chondrophore behind the cardinals; hinge of right valve consisting of an oblique anterior cardinal (1) and strong elongate laterals forming sockets with margin of valve; hinge of left valve consisting of a small oblique anterior cardinal (2), a minute middle cardinal (4b), and weak laterals.

Species of *Erycina* s. s. first appear in Eocene deposits, in which they are abundant. They decline in later Tertiary time. Living species are reported from the West Indies and the southeast coast of the United States, but none are known in European waters.

Key to the Bowden species of Erycina s. s.

Shell very inequilateral..... *E. (E.) olssoni*
Shell slightly inequilateral..... *E. (E.) pura*

Erycina (Erycina) olssoni, new species.

(Plate 18, Figures 4, 5.)

The following is a description of this species:

Shell small, thin, elongate, subquadrate, very inequilateral, anterior end extended; anterior dorsal margin and ventral margin subparrallel; middle of ventral margin obscurely insinuated by a slight compression of shell near margin; posterior margin rounded, anterior margin more convexly rounded; umbos low, placed near posterior end; sculpture consisting of fine, inconspicuous incrementals; right cardinal curved parallel to margin; right laterals strong; chondrophore small, deep.

Length 4.5 mm.; height 2.5 mm.; diameter (right valve) 0.8 mm.

Externally this species resembles *Neaeromya quadrata* Gabb, described from the Dominican Republic, but is longer and more quadrate. Pilsbry has shown that *Neaeromya quadrata* is not an *Erycina,* as the laterals described and figured by Gabb do not exist. An *Erycina,* very similar to *E. olssoni,* though smaller, was collected from the Gurabo formation of the Dominican Republic.

Type material.—Holotype (right valve, 1 of 2 specimens in Henderson collection labeled *Erycina quadrata* Gabb, U. S. Nat. Mus. No. 135687).

Erycina (Erycina) pura, new species.

(Plate 18, Figures 6, 7.)

The following is a description of this species:

Shell medium-sized, thin, substranslucent, elongate, moderately inflated, slightly inequilateral; anterior end extended and more convexly rounded; anterior dorsal margin straight, gently sloping, rounding into curve of anterior end; posterior dorsal margin shorter, convex, curving more evenly into the rounded posterior end; base straight; umbo low, acute, placed behind the middle; median ventral part of shell slightly constricted; sculpture consisting of fine concentric striae; hinge of right valve consisting of an anterior cardinal and strong laterals; chondrophore very small.

Length 8 mm.; height 5 mm.; diameter (right valve) 1.5 mm.

This species is represented by a right valve. It is longer and less inequilateral than *E. olssoni.* It resembles the Miocene and Pliocene species *E. carolinensis* Dall, but is smaller, more elongate, and more inflated.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352817).

Family SPORTELLIDAE?

Genus NEAEROMYA Gabb.

Gabb, 1872, Proceedings Academy of Natural Sciences of Philadelphia, vol. 24, p. 274.

Type (by monotypy).—Neaeromya quadrata Gabb. Miocene, Dominican Republic.

The following is a description of the genus *Neaeromya:*

Shell small, elongate, subquadrate, inequilateral, anterior end longer; sculpture consisting of concentric striae, and (on the type species) of minute radial markings; hinge of right valve consisting of an oblique anterior cardinal (1); left valve edentulous, anterior margin of valve at hinge functioning as a tooth; chondrophore narrow, directed obliquely backward; prodissoconch small, circular.

Gabb's figure of *Neaeromya quadrata* showing a left cardinal and right and left laterals supported the supposition that it represented an *Erycina.* Pilsbry has shown that these hinge features were imaginary. *Neaeromya* seems to be a valid genus. The prodissoconch and hinge of the right valve resemble *Sportella,* but there is no trace of an external ligament. The type of the genus, the Bowden species *N. menotreta,* and *Monacuta? actinophora* Dall, from the Oak Grove sand of Florida, seem to be the only described species. *Montacuta hispaniolae* Maury, from the Cercado formation of the Dominican Republic, is a *Neaeromya,* but seems to be *N. quadrata.*

Neaeromya menotreta, new species.

(Plate 18, Figures 8, 9.)

The following is a description of this species:

Shell small, slightly inflated, elongate subquadrate, very inequilateral; anterior margin rounded, posterior margin almost vertically subtruncate,

base slightly arcuate, descending toward anterior end; posterior dorsal margin short, slightly convex, sloping steeply, rounding gently into posterior subtruncation; umbo low, placed at about posterior third of length; sculpture consisting of fine concentric lamellae; chondrophore narrow, extending obliquely backward; hinge of left valve endentulous, anterior margin of shell at hinge extended; right valve not known.

Length 5.2 mm.; height 3.5 mm.; diameter (left valve) 1 mm.

This species is known only from the holotype, a left valve. It is similar to a species described from the Oak Grove sand of Florida, *Montacuta ? actinophora* Dall, but is smaller and more inequilateral, and has stronger concentric sculpture and no radial sculpture. The same differences separate it from *N. quadrata* Gabb, the type of the genus, which seems to be confined to the Cercado formation of the Dominican Republic.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352818).

Superfamily CARDIACEA.

Family CARDIIDAE.

Genus CARDIUM Linné.

Subgenus CARDIUM s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 678.

Type (by subsequent designation, Gray 1847.)—Cardium costatum Linné. Recent, Indo-Pacific.

The following is a description of the subgenus *Cardium* s. s.:

Shell large, quadrate, strongly inflated, equilateral, gaping behind; umbos high, wide; sculpture consisting of very wide ribs having high narrow hollow crests; hinge of right valve consisting of conical anterior (3*a*) and posterior (3*b*) cardinals, 2 anterior laterals and a posterior lateral; hinge of left valve consisting of 2 conical cardinals (2 and 4*b*) placed almost under each other, and an anterior lateral and 2 posterior laterals.

C. aculeatum usually is given as the type of *Cardium,* as Lamarck gave only this species in the Prodrome. According to a rigid application of the rules this failed to fix the type. Cardiums of the group of *C. costatum* have been placed in *Tropidocardium* Roemer.

There are no species of *Cardium* s. s. in the Bowden fauna.

Subgenus ACANTHOCARDIA Gray.

Gray, 1851, List of specimens of British animals in collection of British Museum, part 7, p. 23.

Type (by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1887).—*Cardium aculeatum* Linné. Recent, seas of Europe.

The following is a description of the subgenus *Acanthocardia:*

Shell medium-sized, inequilateral, rhomboid, slightly gaping at posterior end; umbos wide, high; sculpture consisting of wide ribs having spines rising from a median groove; hinge consisting of 2 cardinals in each valve placed along an oblique line, 2 right anterior laterals, a right posterior

lateral, and left anterior and posterior laterals, indented on their lower surface.

The difference in sculpture is the most striking difference between *Acanthocardia* and *Cardium* s. s.

The Bowden species *C. dissidepictum* does not fit precisely into any described group of Cardiums. It is not an *Acanthocardia,* as its sculpture consists of open spines alternating in size in successive rows in the central part of the shell. The alternating spines suggest the Cretaceous subgenus *Criocardium* Conrad (type, *Cardium dumosum* Conrad), but *Criocardium* has solid spines rising from the interspaces.

Similar Cardiums are unknown in West Indian and adjacent American waters after Miocene time.

Cardium (Acanthocardia?) dissidepictum, new species.

(Plate 18, Figures 10, 11.)

The following is a description of this species:

Shell small, subequilateral, suborbicular, lower part of posterior margin obliquely subtruncate; umbos full and broad, but not very high; sculpture consisting of 43 low radial ribs that are flat-topped, but slightly raised at their margins, separated by narrower, sharply defined channeled interspaces; each rib bears a row of laterally compressed triangular large or small hollow spines, their open ends directed toward ventral margin; in middle part of shell ribs having large spines alternate with ribs having small spines; at anterior end large spines predominate and at posterior end small ones; internal surface bearing relatively conspicuous radial markings.

Lenght 23 mm.; height 23.4 mm.; diameter (left valve) 9.5 mm.

This curiously sculptured species is represented by 2 complete valves and several fragments. A restored broken valve has approximately the following dimensions: length 35 mm.; height 37 mm.; diameter 14 mm. Where the spines have been removed the ribs are smooth and flat and their margins are thin and slightly raised; if erosion proceeds further, the middle of the rib is excavated and the raised margins remain as narrow ridges.

C. dissidepictum resembles *C. acrocome* Dall, a species from the Chipola formation of Florida, but is larger and its long spines are less upturned. It also resembles *C. cinderellae* Maury, from the Gurabo formation of the Dominican Republic, but is smaller and has spines of more uniform size.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352819).

Subgenus TRACHYCARDIUM Mörch.

Section TRACHYCARDIUM s. s.

Mörch, 1853, Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, part 2, p. 34.

Type (by subsequent designation, Dall 1900).—Cardium isocardia Linné. Recent, West Indies.

The following is a description of the section *Trachycardium* s. s.:

Shell medium-sized, inequilateral, high; sculpture consisting of moderately wide ribs having (on the type species) inverted U-shaped lamellae on the posterior part of their crest; hinge of right valve consisting of a heavy posterior cardinal (3*b*), a scarcely distinguishable anterior cardinal (3*a*), and 2 anterior and posterior laterals; hinge of left valve consisting of a heavy anterior cardinal (2), a scarcely distinguishable posterior cardinal (4*b*), and an anterior and posterior lateral indented on their lower surface.

Trachycardium differs from *Acanthocardia* principally in outline and sculpture. Species of *Trachycardium* first appear in Upper Cretaceous deposits. The Tertiary and living species have an extensive distribution.

Key to the Bowden species of Trachycardium.

Crest of ribs frilled.
- Shell medium sized, height exceeding length..... *C. (T.) lingualeonis*
- Shell small, height and length almost equal..... *C. (T.) bowdenense*

Crest of ribs not frilled.
- Shell small..... *C. (T.) inconspicuum*
- Shell large..... *C. (T.) waylandi*

Cardium (Trachycardium) lingualeonis Guppy.

(Plate 18, Figures 12, 13.)

Cardium lingua-leonis Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, plate 18, fig. 7. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 422 (list). Not Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531 (= *C. dominicanum* Dall, 1900).

Cardium (Trachycardium) lingualeonis Guppy, Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1084.

The following is the original description of this species:

Shell elongate, subquadrate; valves deep, ornamented with numerous (32) nodosely muricate ribs, which are lower and more distant toward the anterior and posterior margins; margins coarsely crenulate, the posterior one strongly serrate; hinge with 3 large and stout teeth.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell moderately large, longitudinally subovate, strongly inflated; umbos high, prominent; sculpture consisting of 31 to 33 strong radial ribs separated by narrow deeply channeled interspaces; 5 anterior ribs bear median, disconnected globular nodules which on large shells are absent from the broader outer half of the ribs; the next 16 or 17 ribs ornamented with a raised frill placed on the posterior side and overhanging the interspaces, the ornamentation consisting of oblique medially swollen beads bearing attenuated and joined extremities, producing a spiral effect; toward the center of the shell the frill becomes narrower, beyond the center the frill becomes wider and separated from the smooth part of the rib by a groove; on the 10 posterior ribs the line of beads gradually assumes a central position on the ribs, the beads themselves becoming wider, transversely swollen or globular, and almost or entirely disconnected; these posterior ribs are lower and the interspaces wider; fine concentric threads may ornament the interspaces on any part of the shell.

Length 37 mm.; height 48 mm.; diameter (right valve) 19.5 mm.

This species is the Bowden representative of the *C. isocardia* Linné group. The sculpturing is very elaborate and on parts of the shell suggests, as Dall has aptly remarked, twisted ribbons of candy. When the highly ornamented frill is eroded the ribs are flat or subrounded and smooth, except for a narrow median groove. Young shells are less elongate and more orbicular than adults.

Brown and Pilsbry have described a very similar species, *C. stiriatum,* from the Gatun formation of the Canal Zone. It is a little smaller and has slightly heavier sculpture of the same type. *C. lingualeonis, C. stiriatum, C. cestum* Dall (Chipola formation) *C. delphicum* Dall (Oak Grove sand), *C. emmonsi* Conrad (Waccamaw and Caloosahatchee marls), *C. isocardia* Linné (Duplin and Caloosahatchee marls; Recent, West Indies), and *C. belcheri* Broderip (Recent, Gulf of California) constitute a well-defined group and differ principally in ornamentation.

Type material.—Holotype (British Museum, Natural History, Geological Department, No. 64090).

Cardium (Trachycardium) bowdenense Dall.

(Plate 18, Figures 14 to 16.)

Cardium (*Trachycardium*) var? *bowdenense* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, pp. 1087–1088.

Not *Cardium* (*Trachycardium*) *bowdenense* Dall, 1915, Bull. U. S. Nat. Mus. No. 90, p. 143.

The following is the original description of this species:

This species from the Bowden marl and from the silex beds at Ballast Point, Tampa Bay, Florida, was identified with the recent *muricatum* by Guppy. It has about the same number of ribs (37 to 41) and the sculpture is much the same in character, but the similarities are all in miniature; the shell is always small (alt. 15.5, lon. 15.5, diam. 9 mm. for the largest seen), less inflated proportionally than *C. muricatum* of the same size, with the ribs more compressed and crowded. *C. muricatum* has not been found in any horizon between Bowden and the Pleistocene, which is in itself a strong reason for doubting whether the older shell is identical with the newer. I therefore propose for it the name of *bowdenense,* which, if connecting links should hereafter be found, may be regarded as of varietal value.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell small, moderately inflated, slightly inequilateral, suborbicular, anterior end more convex than posterior and curving more broadly into base; umbos low, moderately inflated; sculpture consisting of 39 to 42 low, subrounded ribs separated by interspaces of the same width or slightly narrower; interspaces usually crossed by fine concentric threads; ribs ornamented with a single row of more or less globular or transversely swollen beads; on the anterior 8 or 9 ribs the beads are largest and occupy the entire width of the ribs; on the next 7 ribs the beads are progressively shifted to the anterior side; of the succeeding 14 ribs on the first few the

beads again occupy the entire width of the rib, but on the remainder the beads gradually are shifted to the posterior side and the interspaces between the ribs becoming slightly deeper; the 10 posterior ribs are characterized by a narrow anterior keel and a lower broader posterior part on which the beads lie; interspaces between posterior ribs relatively wide and shallow.

Length 19.5 mm.; height 19.3 mm.; diameter (right valve) 7 mm.

The valve measured is much larger than any other. The ribs on the middle of the shell are slightly narrower than those at either end. On most young shells the low posterior part of the 10 posterior ribs is absent, so that the beads lie in the interspaces.

C. bowdenense closely resembles the living West Indian *C. muricatum* Linné. Besides the differences given in the original description, *C. bowdenense* has more rounded beads and none of the ribs bear two rows of beads. These two species, *C. presursor* Dall (Byram marl), *C. parile* Dall (Chipola formation), *C. virile* Dall (Chipola formation), *C. malacum* Dall (Oak Grove sand), and *C. oedalium* Dall (Waccamaw and Calooshatchee marls) differ in size and details of sculpture. The species from the Tampa formation described as *C. bowdenense* is shorter and more inflated and has slightly wider ribs.

Type material.—2 specimens (probably cotypes, but not labeled types, U. S. Nat. Mus. No. 115667).

Cardium (Trachycardium) inconspicuum Guppy.

(Plate 19, Figures 1, 2.)

Cardium inconspicuum Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, plate 18, fig. 12. Guppy, 1874, Geol. Mag. dec. 2, vol. 1, p. 442 (list). Not Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531 (= *C. dominicense* Gabb, 1873).

Cardium (*Trachycardium*) *inconspicuum* Guppy, Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1082.

The following is the original description of this species:

Shell elongate, subtrigonal, ovate, ornamented with numerous (38) imbricate radiating ribs broader than their regularly squamose interspaces; umbones scarcely prominent; margins strongly dentate; hinge small, with 3 teeth.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell medium-sized, thin, subequilateral, broadly subovate; umbos low; sculpture of adult shell consisting of 40 or 41 narrow, low, subrounded ribs separated by narrow interspaces; anterior 10 to 13 ribs ornamented with transverse or slightly oblique beads; toward the posterior end of the shell the beads are progressively confined to the lower end of the ribs; toward the center of the shell the ribs become slightly narrower; these ribs, as well as the nonbeaded parts of the anterior ribs, are crossed by arched concentric threads, the convex side of the arch directed toward the umbo; in the interspaces the concentric threads are inconspicuous; toward the posterior end similarly sculptured ribs become broader and the interspaces wider;

the 8 posterior ribs are lower and smooth, except for a row of distant fine beads on their posterior edge.

Length 30 mm.; height 35 mm.; diameter (right valve) 10.5 mm.

This species resembles *C. dominicense* Gabb, a Miocene species from the Dominican Republic, but is smaller, and has lower and narrower umbos and fewer ribs. *C. linguatigris* Maury, from the Cercado formation of the Dominican Republic, closely resembles *C. inconspicuum,* but is larger and apparently its relative height is greater.

A worn broken valve from the Chipola formation called *C. inconspicuum* (U. S. Nat. Mus. No. 114771) has narrower ribs and wider interspaces.

Type material.—Holotype (British Museum, Natural History, Geological Department, No. 64091).

Cardium (Trachycardium) waylandi, new species.

(Plate 19, Figures 3, 4.)

The following is a description of this species:

Shell large, broadly subovate, subequilateral, anterior margin curving more convexly than posterior; umbos full, moderately high; sculpture consisting of 35 low, flat, broad radial ribs, overhanging very narrow, deeply channeled interspaces; lower part of anterior 4 or 5 ribs obscure, producing an almost smooth slightly beaded area; the next 23 ribs have faint longitudinal striae and fine growth-line, more prominent and oblique on the anterior ribs of this series and arched on the remaining ones; the edges of the ribs, especially on the anterior side, are finely beaded; the last 2 or 3 interspaces of this series are not channeled; lower part of the posterior 8 ribs scarcely separated by slightly depressed grooves, which becomes broader and deeper toward the umbo, these ribs are crossed by asymmetrically arched growth-lines and the last 3 or 4 interspaces bear, on their upper half, small globular beads; ventral half of interior surface bearing obscure grooves running up from the fluted margin.

Length 50 mm.; height 63 mm.; diameter (right valve) 20.5.

This species is represented by several entire valves and fragments of much larger ones. One of these fragments is part of a valve having approximately the following dimensions: length 72 mm.; height 115 mm.; diameter 31 mm. If the surface is eroded, the ribs have the appearance of bearing flat imbricating arched scales, which on the umbo are transformed into narrow transverse beads. *C. waylandi* closely resembles *C. declive* Gabb, a species from Costa Rica probably of Miocene age, but is larger and differs slightly in outline. Both species are similar to the living West Indian species known as *C. leucostomum* Born, *C. marmoreum* Lamarck, and *C. subelongatum* Sowerby, but have wider ribs and narrower interspaces. Externally, *C. waylandi* resembles a Pliocene species from Florida, *C. dalli* Heilprin, but has a wider dorsal margin and higher umbos, and lacks the internal umbonal ridge of *C. dalli.*

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352822).

Subgenus FRAGUM Bolten.

Section FRAGUM s. s.

Bolton, 1798, Museum Boltenianum, part 2, p. 189.

Type (by subsequent designation, Dall 1900).—Cardium unedo Linné. Recent, Indo-Pacific.

The following is a description of the section *Fragum* s. s.:

Shell medium-sized, rhomboidal, strongly inflated, posterior end truncate, posterior ridge subangular; sculpture consisting of many flat-topped ribs bearing thin obscure beads, which usually are eroded; hinge similar to *Trachycardium*.

The truncated posterior end and posterior ridge are characteristic features of *Fragum* s. s. The earliest American species are of Miocene age. No Tertiary or living species have been described from Europe. The living species are confined to the Atlantic and Pacific coasts of American, and the Indo-Pacific and West African regions.

Key to the Bowden species of Fragum s. s.

Shell medium-sized, posterior ridge angular..... *C. (F.) medium*
Shell small, posterior ridge rounded..... *C. (F.) elattocostatum*

Cardium (Fragum) medium Linné.

(Plate 19, Figures 5, 6.)

Cardium medium Linné, 1758, Syst. Nat., ed. 10, p. 678. Reeve, 1844, Conch. Icon., vol. 2, *Cardium*, plate 2, fig. 30. Roemer, 1869, Conch. Cab., Neue Ausg. p. 102, plate 4, figs. 5 to 7.

Cardium venusium Dunker, 1861, Mal. Blät., vol. 6, p. 37.

Cardium (Fragum) medium Linné, Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 374, 1881. Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1101-1102. ? Glenn, 1904, Maryland Geol. Survey Mioc. vol., p. 322, plate 86, figs. 6*a*, 6*b*. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, pp. 389–399, plate 30, fig. 6.

Hemicardium columba Heilprin, 1886, Trans. Wagner Free. Inst. Sci. Philadelphia, vol. 1, p. 93, plate 11, fig. 26.

Cardium (Fragrum) sp. indet., Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1101.

The following is a description of Bowden specimens of this species:

Shell medium-sized, roughly subquadrate; anterior margin rounding broadly into base; upper part of posterior margin flexed outward, lower part subtruncate, meeting base at an angle of about 90°; umbos full, relatively high and narrow; posterior ridge strong, subangular; upper part of depressed posterior area elevated; sculpture consisting of 36 to 40 low subrounded or rounded ribs, separated by narrower interspaces; ribs and interspaces increasing in size from anterior end to posterior ridge; the 8 to 10 ribs behind the ridge asymmetrically rounded, slightly overturned toward anterior end of shell; unworn surfaces of ribs showing arched narrow growth lines.

Length 28 mm.; height 34 mm.; diameter (right valve) 13 mm.

On most shells the ribs are intact on only a few small patches. If this surface is removed both ribs and interspaces bear fine concentric threads, which, as usual, are arched on the ribs.

The largest Bowden specimens are not much more than half as large as the largest living specimens of *C. medium* from the West Indies, but they seem to agree with specimens of the same size. Miocene specimens from Costa Rica are larger than Bowden specimens.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica. St. Marys formation (upper Miocene), Maryland (probably a different species). Duplin marl (upper Miocene), North Carolina. Waccamaw marl (Pliocene), North Carolina. Caloosahatchee marl (Pliocene), Florida. Living, Cape Lookout to the West Indies and Colombia in less than 50 fathoms, except in the West Indies, where it occurs in both shallow and deep water.

Cardium (Fragum) elattocostatum, new species.

(Plate 19, Figure 7.)

The following is a description of this species:

Shell small, subquadrate, moderately inflated; anterior margin broadly rounded, posterior margin truncate, base arcuate, rounding into anterior margin and meeting posterior margin at an angle of more than 90°; umbos narrow; posterior ridge moderately strong, subrounded or rounded; sculpture consisting of 18 to 21 subrounded ribs on the part of shell anterior to ridge, and 8 to 10 behind the ridge; interspaces as wide as ribs in central part of shell, but narrower in posterior area and in extreme anterior part; ribs bearing at relatively distant intervals transverse or rounded beads, between which may lie very fine concentric threads; interspaces crossed by coarser narrow concentric threads.

Length 7.9 mm.; height 8.1 mm.; diameter (right valve) 2.6 mm.

A few smaller valves have a slightly insinuated posterior margin, and in this feature resemble *C. medium*. Such valves may readily be distinguished from small specimens of *C. medium* of the same size, as they are less inflated, less sharply ridged, and have lower umbos and fewer ribs.

C. elattocostatum closely resembles *C. burnsii* Dall from the Chipola marl of Florida, but has higher and narrower umbos, more rounded posterior ridge, fewer ribs, deeper interspaces and coarser concentric threads in the interspaces. The Bowden species, like *C. burnsii* for which Dall has pointed out the relation, is intermediate between *Fragum* and *Trigoniocardia,* having the numerous similar ribs of *Fragum* and the striated interspaces of *Trigoniocardia.*

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352824).

Section TRIGONIOCARDIA Dall.

Dall, 1900, Proceedings U. S. Nat. Mus., vol. 23, p. 384.

Type (by original designation).—Cardium graniferum Sowerby. Recent, Pacific coast of Central America.

The following is a description of the section *Trigonicardia:*

Shell small, strongly inflated, rhomboidal, posterior end truncate, posterior ridge subangular; sculpture of part of shell in front of posterior ridge consisting of a few narrow ribs bearing beads, which often are eroded; interspaces sculptured with looped concentric lamellae; sculpture of part of shell behind posterior ridge consisting of lower and more crowded ribs.

All the described species of *Trigoniocardia* are relatively small. The interspaces in front of the posterior ridge are wider and more elaborately sculptured than in other sections of *Fragum.* Living and fossil species of *Trigoniocardia* are confined to American waters—the West Indies, the southeast coast of the United States, and the Pacific coast of Central America. The earliest species are of Eocene age.

Key to the Bowden species of Trigoniocardia.

Posterior ridge not strongly curved, 13 to 15 ribs in front of posterior ridge; shell medium-sized or large..... *C. (C.) haitense*

Rib on posterior ridge not more prominent than those in front of ridge. *C. (T.) haitense haitense*

Rib on posterior ridge more prominent than those in front of ridge. *C. (T.) haitense cercadicum*

Posterior ridge strongly curved, 10 ribs in front of posterior ridge; shell small. *C. (T.) thaumastum*

Cardium (Trigoniocardia) haitense haitense Sowerby.

(Plate 19, Figures 8, 9.)

Cardium haitense Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 52, plate 10, fig. 11. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293. Guppy (part), 1874, Geol. Mag. decade 2, vol. 1, p. 442, (list.) Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531.

Cardium (Fragum) haitense Sowerby, Gabb, 1872, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 251.

Cardium (Trigoniocardia) haitense Sowerby, Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 379, pl. 62, figs. 5, 5*a*. Maury, 1920, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 1, pp. 35-36, New York Acad. Sci. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 421.

The following is the original description of this subspecies:

Testa oblique subovata gibbosa, radiatim costata, lateribus brevibus, costis quatuor et viginti, quadratis, graniferis, interstiis creberrime regulosos; angulo postico rotundato ex umbone ad marginem inferiorem posticam decurrente.

Type locality.—Dominican Republic.

The following is a description of Bowden specimens of this subspecies:

Shell relatively large; posterior margin almost vertically truncate; umbos full, high; part of shell in front of posterior ridge sculptured with 13 to 14 high, flat-topped ribs, separated by squarely depressed deep interspaces of virtually the same width; area behind ridge bearing 9 lower ribs, interspaces usually narrower than ribs; interspaces sculptured with relatively coarse concentric threads that are arched (with the concave side toward the umbo) in the region immediately anterior to the ridge and also in the posterior area where they may cross the ribs; some or all of the ribs bear beads that

are globular in the umbonal and the extreme anterior and posterior parts of the shell, and transversely swollen elsewhere; the first 9 or 10 ribs are progressively wider, and the first 5 or 6 interspaces wider than elsewhere; the remaining ribs up to the posterior ridge usually are squarely keeled, the concentric threads of the interspaces present on the lower part of the rib, but not on the keel; immediately behind the ridge both ribs and interspaces are narrower than elsewhere, but they increase slightly in width toward the posterior end.

Length 18 mm.; height 22 mm.; diameter (left valve) 7 mm.

This subspecies is the most abundant of all the Bowden bivalves. The largest specimens are larger than specimens from the Gurabo formation of the Dominican Republic, from which the shells described by Sowerby probably were collected. Bowden specimens are considerably larger and have wider ribs than specimens from the Cercado formation.

Other localities.—Porto Rico, Quebradillas limestone ? (lower Miocene); Cercado formation (lower Miocene), Dominican Republic; Gurabo formation (middle Miocene), Dominican Republic; Miocene (middle ?), Curaçao.[1]

Type material.—10 cotypes (Geol. Soc. London, No. 12790–12791) deposited in British Museum (Natural History), Geological Department.

Cardium (Trigoniocardia) haitense cercadicum Maury.

(Plate 19, Figures 10, 11.)

Cardium (*Trigoniocardia*) *haitense* var. *cercadicum* Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 376, plate 62, fig. 6. Maury, 1920, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 1, p. 36, New York Acad. Sci. Hubbard, 1921, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 2, p. 117, plate 19, fig. 8, New York Acad. Sci.

The following is an abstract from the original description of this subspecies:

This form differs from the typical in its sharply angulated posterior slope and produced posterior margin. Ribs usually ten on the truncation, fourteen on the body, ornamental with nodules pointing upward.

Type locality.—Bluff 2, Rio Mao, Dominican Republic.

The following is a description of Bowden specimens of this subspecies:

Shell small, resembling in outline *C. haitense haitense*, but having a more angular posterior ridge; part of shell in front of ridge sculptured with 14 or 15 narrow, square ribs, separated by narrower squarely, but not very deeply, depressed interspaces; rib on ridge wider and higher than those immediately preceding; area behind ridge sculptured with 10 similar, but narrower ribs, the interspaces much narrower than the ribs; ribs ornamented with beads, which are globular, except in the median ventral part, where they are transversely swollen; interspaces sculptured with relatively prominent concentric threads.

Length 11 mm.; height 13.5 mm.; diameter (left valve) 4.8 mm.

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[1] See footnote on page 25.

This subspecies is represented by a large number of small shells that closely resemble small specimens of *C. haitense haitense*. The emphasizing of the angular posterior ridge by a rib that is wider, higher, and more rounded than those preceding or following, and the slightly narrower and shallower interspaces separate this subspecies from young shells of *C. haitense haitense*.

The interspaces of the Bowden specimens are not quite so deep as on specimens from the Cercado formation. In the Dominican Republic this subspecies is confined to the Cercado formation. Maury and Hubbard record it from Miocene beds in Porto Rico.

Other localities.—Cercado formation (lower Miocene), Dominican Republic. Quebradillas limestone and Ponce limestone (lower Miocene), Porto Rico.

Type material.—Cornell University.

Cardium (Trigoniocardia) thaumastum, new species.

(Plate 19, Figures 12, 13.)

The following is a description of this species:

Shell small, oblique, greatly inflated; umbos high, strongly prosogyrate; posterior ridge angular, curved; part of shell in front of ridge sculptured with 10 relatively wide ribs, increasing in width from anterior margin to center of shell and then slightly decreasing; rib on the posterior ridge subrounded, the others flat; anterior interspaces narrower than ribs, toward the ridge they become wider and much deeper; posterior area depressed, ornamented with 7 narrow, low flat ribs, wider toward margin of shell; some or all ribs ornamented with small globular nodules, becoming slightly transversely elongate in median ventral region; interspaces sculptured with fine concentric threads.

Length 7.6 mm.; height 10 mm.; diameter (right valve) 4 mm.

This species is represented by the holotype, a right valve. It is characterized by the strong curved ridge and deep interspaces between the ribs immediately in front of the ridge. It is similar to *C. aminense* Dall, from the Gurabo formation of the Dominican Republic, but is smaller and longer, and has a more strongly curved posterior ridge and more crowded concentric threads in the interspaces.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352827).

Subgenus LAEVICARDIUM Swainson.

Swainson, 1840, A Treatise on Malacology, p. 373.

Type (by subsequent designation, Bucquoy, Dautzenberg, und Dollfus, 1887).—Cardium europaeum Wood (=*C. norvegicum* Spengler). Recent, west coast of Europe and Mediterranean.

The following is a description of the subgenus *Laevicardium:*

Shell medium-sized, thin, obliquely subovate; posterior and anterior ends smooth, rest of shell smooth or sculptured with indistinct ribs; laterals strongly bent upward and outward.

The outline, weak sculpture and bent laterals are characteristic features of *Laevicardium*. The Tertiary and living species have an extensive distribution.

Cardium (Laevicardium) serratum Linné.

(Plate 19, Figures 14 to 16.)

Cardium serratum, Linné, 1758, Syst. Nat. ed. 10, p. 680. Gmelin, 1767, Syst. Nat., ed. 12, p. 1123. Reeve, 1844, Conch. Icon. vol. 2, *Cardium,* plate 1, fig. 1. d'Orbigny, 1846, Voy, Amer. Merid., Mol., p. 590. d'Orbigny, 1853, in de la Sagra, Hist. phys., polit. et natur. de l'Ile de Cuba, Mollusques, vol. 2, p. 304 (French ed.) Dall, 1881, Bull. Mus. Compt. Zool. Harvard, vol. 9, p. 131. Dall, 1886, Bull. Mus. Compt. Zool. Harvard, vol. 12, p. 270. Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 327.

Cardium citrinum serratum Chemnitz, 1782, Conch. Cab., vol. 6, p. 194, plate 18, fig. 189.

Cardium citrinum Wood, 1815, Gen. Conch., p. 223, plate 54, fig. 3.

Cardium laevigatum Lamarck (not Linné, or Born), 1819, Anim. sans Vert., vol. 6, p. 11.

Cardium oviputamen Reeve, 1844, Conch. Icon., vol. 2, *Cardium,* plate 7, fig. 36.

Liocardium pictum Ravenel, 1862, Proc. Acad. Nat. Sci. Philadelphia, for 1861, p. 44.

Cardium (*Laevicardium*) *serratum* Linné, Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 374. Dall, 1900, Trans. Wagner Free. Inst. Sci. Philadelphia, vol. 3, part 5, pp. 1110-1111. Dall, 1901, Proc. U. S. Nat. Mus., vol. 23, p. 387. Dall and Simpson, 1902, Bull. U. S. Fish Comm., vol. 20, part 1, p. 489. Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci., Philadelphia, vol. 63, p. 367. Maury, 1917, Bull. Amer. Paleontology, vol. 5 pp. 376-377, plate 62, fig. 8. Maury, 1920, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 1, pp. 36-37, New York Acad. Sci. Pilsbry, 1922, Proc. Acad. Nat. Sci., Philadelphia, vol. 73, p. 421. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 400, plate 30, figs. 11, 12. Not *Laevicardium serratum* Böse, 1906, Bol. Inst. Geol. Mexico, No. 22, p. 80, plate 11, fig. 5.

The following is a description of Bowden specimens of this species:

Shell medium-sized, fragile, posterior end usually obliquely extended; outline varying from obliquely subovate-trigonal to almost suborbicular; umbos full, moderately high; posterior ridge distinct on umbonal half of shell, broadly rounded on lower half; anterior and posterior ends of shell having no radial markings, posterior smooth area wider than anterior; remainder of shell bearing numerous equally spaced faint radial markings; entire surface of shell having fine concentric markings, which are more regular and coarser in umbonal region; inner margin of valve minutely fluted; ventral half of internal surface having numerous faint radii.

Length 40 mm.; height 36 mm.; diameter (left valve) 13 mm.

Only a few Bowden specimens of this species are large and have an oblique outline. Small valves have an outline that ranges from obliquely elongate to almost subcircular. The external radial markings hardly affect the contour of unworn surfaces of the shell. The surface is usually eroded and both the radial and concentric markings stand in slight relief, producing a cancellate effect.

C. venustum Gabb, a similar species from the Cercado formation of the Dominican Republic, has fuller and higher umbos, and heavier

cardinals. *C. serratum* has been collected from the Cercado and Gurabo formations. *C. dalli* Toula, from the Gatun formation, seems to have more conspicuous sculpture. The cast figured by Böse from Santa Maria Tatetla, Vera Cruz, Mexico, has much wider umbos than *C. serratum*.

Other localities.—Quebradillas limestone ? (lower Miocene), Porto Rico. Cercado formation (lower Miocene), Dominican Republic. Gurabo formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama Canal Zone and Costa Rica. Choctawhatchee marl (upper Miocene), Florida. Caloosahatchee marl (Pliocene), Florida. Pleistocene, southern Florida. Living, Hatteras to the West Indies in less than 75 fathoms.

Genus PROTOCARDIA Beyrich.

Section PROTOCARDIA s. s.

Beyrich, 1845, Zeitschrift für Malakozoologie, Jahrgang 1845, p. 18.

Type (by subsequent designation).—Cardium hillanum Sowerby. Cretaceous, England.[1]

The following is a description of the section *Protocardia* s. s.:

Shell medium-sized, orbicular-quadrate, strongly inflated; posterior part of shell sculptured with smooth radial ribs, remainder of shell sculptured with concentric rugae; hinge of right valve consisting of a small anterior cardinal (3*a*), a heavier posterior cardinal (3*b*), and subequal anterior and posterior laterals, the anterior one farther from the cardinals than the posterior; hinge of left valve consisting of a heavy anterior cardinal (2), a smaller posterior cardinal (4*b*), and an anterior and posterior lateral, the anterior one larger and heavier than the posterior and more upturned; margin of valve fluted at posterior end.

There seems to be no Tertiary or living species of *Protocardia* s. s.

Section NEMOCARDIUM Meek.

Meek, 1876, Report U. S. Geol. Sur. of the Territories, vol. 9, p. 167.

Type (by monotypy).—Cardium semiasperum Deshayes. Eocene, Paris Basin.[2]

The following is a description of the section *Nemocardium:*

Shell small or medium-sized, orbicular-quadrate, strongly inflated, subequilateral; posterior part of shell sculptured with spiny radial ribs, remainder of shell sculptured with smooth or beaded radial ribs, or engraved radial lines; hinge resembling *Protocardia* s. s., but the right cardinals are joined; right laterals slightly upturned, the posterior longer than the anterior; left anterior (2) cardinal heavier and more upturned than the posterior (4*b*); margin of valve finely fluted.

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[1] I have not had access to specimens of the type species showing the hinge. The description of the hinge is based on figures given by Woods (A Monograph of the Cretaceous Lamellibranchia of England, vol. 2, part 5, pp. 197–201, plate 31, figs. 6*a* to 6*c*, plate 32, figs. 1 to 6, 1908).

[2] I have not seen the type species. The description is based on *Cardium edwardsi* Deshayes, Eocene, Paris Basin.

The spiny posterior ribs, radial sculpture on the remainder of the shell, and united right cardinals separate this section from *Protocardia* s. s. Species are abundant in Eocene deposits, but the section declines after Eocene time. Some of the Eocene species are large. In Europe the section disappeared during Miocene time, but it is still represented in West Indian waters by *P. peramabilis* Dall and *P. tincta* Dall.

Protocardia (Nemocardium) jamaicensis Dall.

(Plate 19, Figure 17.)

Protocardia jamaicensis Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1114; 1903, part 6, plate 48, fig. 3.

The following is the original description of this species:

Shell small, plump, subquadrate, with rather high subcentral umbones; anterior end evenly rounded, posterior very slightly rounded truncate; surface with very numerous radiating threads crossed by concentric lines evenly disposed, which at the intersections reveal themselves by rendering the radii beaded; this sculpture covers a little less than the anterior half of the disk, behind which the radials are narrower and not beaded, separated by still narrower channels; in the channel separating the anterior from the posterior type of sculpture rises a low crest like a string of small beads, behind which in each second or third channel rises a row of small, stout, very caducous spines, those on the posterior area smaller and shorter than those on the disk; internally the margin is minutely serrate; the hinge is normal. Lon. 6.2, alt. 6.0, diam. 4.5 mm.

Type locality.—Bowden, Jamaica.

This species is represented by the holotype, a left valve, and a broken right valve. The holotype is glued to cardboard, so that the hinge can not be figured. It is more orbicular and has lower umbos and wider posterior area than *P. islahispaniolae* Maury, from the Gurabo formation of the Dominican Republic, and *P. costaricensis* Olsson, a Miocene species from Costa Rica.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135733).

Superfamily ISOCARDIACEA.

Family PLIOCARDIIDAE.

Genus PLIOCARDIA, new genus.

Type.—Anomalocardia bowdeniana Dall. Miocene, Jamaica.

The following is a description of the genus *Pliocardia:*

Shell small, heavy, ovate, inequilateral, posterior end rostrate, base slightly emarginate in front of rostrum; lunule large, bounded by a deep narrow groove; sculpture consisting of concentric rugae; hinge consisting of elongate teeth lying under umbo and apparently representing anterior laterals, as in *Isocardia;* on the right valve there is a broad, short anterior tooth (AI), lying along lower edge of hinge plate, and a long, curved posterior tooth (AIII), its anterior end thin and arched, its posterior end thick; left anterior tooth (AII) heavy, divided into a small anterior part and a heavy posterior part; left posterior tooth (AIV) thin and long; poste-

rior laterals absent; pallial sinus very shallow, lying near posterior adductor scar; inner margin of valve bearing oblique grooves except at posterior end.

This genus seems to belong in the superfamily Isocardiacea, although the anterior teeth in both valves are heavier and less elongate than in *Isocardia*. The lunule, rostrate posterior end, and shallow sinus separate *Pliocardia* from all genera in the family Isocardiidae. Therefore, it is put in a new family Pliocardiidae. *Pliocardia* resembles the genus *Vesicomya* Dall, as both genera have a lunule, oblique grooves on the inner edge of the valves, and essentially the same arrangement of teeth. But *Vesicomya* is a thin-shelled deep-water genus; is barely rostrate; and has slender teeth of different shape.

Pliocardia bowdeniana (Dall).

(Plate 20, Figures 1 to 5.)

Anomalocardia bowdeniana Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1304-1305, plate 57, fig. 7.

The following is the original description of this species:

Shell small, ovate-trigonal, subrostrate, with a flexuous base behind; beaks rather high, prosogyrate; lunule large, impressed, well-defined, but with no defined escutcheon, posterior end pointed, anterior rounded, base arcuate, rather prominent mesially; surface sculptured with concentric striae with flattish wider interspaces; hinge normal, rather heavy, inner margins entire; pallial sinus small, angular. Length 4.5, height 3.5, diameter 3.0 mm.

Type locality.—Bowden, Jamaica.

Some of the valves collected since this species was described are considerably larger than the holotype. The largest has the following dimensions: length 10 mm.; height 7 mm.; diameter (right valve) 2.5 mm. The hinge and other features are described on page 147. Apparently no similar species has been described.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135671).

Superfamily VENERACEA.

Family VENERIDAE.

Genus TIVELA Link.

Section TIVELA s. s.

Link, 1807, Beschreibung der Naturalien-Sammlung der Universitat zu Rostock, part 2, p. 152.

Type (by subsequent designation, Dall 1902).—Venus corbicula Gmelin (=*Venus mactroides* Born). Recent, West Indies.

The following is a description of the section *Tivela* s. s.:

Shell medium-sized, trigonal, subequilateral, strongly inflated; umbos high; lunule long, slightly depressed; sculpture consisting only of incrementals; hinge of right valve consisting of 2 anterior lateral lamellae, 3

cardinals (3*a*, 1 and 3*b*), the upper surface of the posterior one (3*b*) rugose, and a narrow posterior rugose area; hinge of left valve consisting of an anterior lateral, the lower surface depressed, 4 cardinals (4*a*, 2*a*, 2*b*, and 4*b*), upper surface of third cardinal (2*b*) (from anterior end) rugose, and upper and lower surfaces of posteriormost cardinal (4*b*) rugose; posterior right and anterior left dorsal margin grooved; pallial sinus moderately deep, wide, apex broadly -shaped.

Tivela jamaicensis Dall is the only described east American Tertiary species. An undescribed species from the Cercado formation of the Dominican Republic is the earliest American species. The earliest European species comes from deposits of Aquitanian age. The living species are confined to tropical West Indian and west African waters, and the Pacific coast of Central America.

Tivela (Tivela) jamaicensis Dall.

(Plate 20, Figures 6, 7.)

Tivela jamaicensis Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1244-1245, plate 57, fig. 9.

The following is the original description of this species:

Shell small, thin, plump, smooth, or faintly concentrically striated; beaks nearly central, low, pointed, turgid; lunule large, lanceolate, smooth, defined by an impressed line; nymphs short and elevated, dorsal slopes nearly straight, ends bluntly rounded, base slightly arcuate; hinge delicate, with 3 small cardinals and a rather long, slender, anterior left lateral; margins thin, smooth; pallial sinus small, rounded. Length 6.0, height 5.5, diameter 4.0 mm.

Type locality.—Bowden, Jamaica.

The holotype, a left valve, is the only specimen of this species. It resembles *T. abaconis* Dall, a living species from the Bahamas, in having a long, slender left anterior lateral, which is distant from the cardinals. It is much smaller than an undescribed species from the Cercado formation of the Dominican Republic.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135675).

Genus GAFRARIUM Bolton.

Subgenus GAFRARIUM s. s.

Section GAFRARIUM s. s.

Bolten, 1798, Museum Boltenianum, part 2, p. 176.

Type (by subsequent designation, Dall 1902).—Venus pectinata Linné. Recent, Indo-Pacific.

The following is a description of the section *Gafrarium* s. s.:

Shell medium-sized, ovate, moderately inflated, umbos low; lunule narrow, limited by a narrow groove; sculpture consisting of beaded radial threads, divaricating at posterior end; hinge of right valve consisting of 2 anterior lateral lamellae and 3 cardinals (3*a*, 1 and 3*b*); hinge of left valve consisting of an anterior lateral, its lower surface depressed, and 3 cardinals (2*a*, 2*b*, 4*b*), the middle one (2*b*) heavy and grooved on the

anterior face; pallial sinus barely indenting pallial line; inner ventral margin fluted.

There are no American species of *Gafrarium* s. s.

Section GOULDIA C. B. Adams.

C. B. Adams, 1847, Catalogue of Genera and Species of Recent Shells in Collection of C. B. Adams, p. 29.

Type (*by subsequent designation, Dall 1902*).—*Thetis cerina* C. B. Adams. Recent, West Indies.

The following is a description of the section *Gouldia:*

Shell small, trigonal-ovate; lunule long, narrow, slightly depressed; sculpture consisting of concentric rugae and less distinct radial threads; hinge resembling *Gafrarium* s. s., but the teeth are more slender and the middle left cardinal (2*b*) is not grooved; inner ventral margin not fluted; inner dorsal margins grooved.

The differences in hinge and sculpture separate *Gouldia* from *Gafrarium* s. s. According to Cossmann, *Gouldia* probably is represented in the Eocene deposits of the Paris Basin. No European Oligocene species are known, but species appear in the Aquitanian and the group continues to the present time in European waters. The earliest American species are of lower Miocene age and species are now living in American waters. No living species are known on the Pacific coast of America.

Gafrarium (Gouldia) insulare (Dall and Simpson).

(Plate 20, Figures 8 to 10.)

Circe (*Gouldia*) *insulare* Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, part 1, p. 487, plate 55, fig. 2.

Gafrarium (*Gouldia*) *insulare* (Dall and Simpson), Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1248.

The following is the original description of this species:

Shell small, yellowish white, quite inequilateral, moderately convex, with a prominent, rather anterior beak; sculpture of small, close-set, subequal, concentric undulations, with narrower interspaces and less pronounced on the umbones, crossed by fine radial striae, which are stronger towards the ends of the valves, where the interspaces sometimes become threadlike; lunule small, sharply defined, rather long and narrow; escutcheon absent; interior white, the margins in many specimens with a fine sulcus parallel to it around the shell; hinge normal; pallial line entire but slightly truncate behind. Length 5.5; height 5; diameter 3 mm.

Type locality.—Mayaguez Harbor, Porto Rico.

This small species is very abundant. A typical adult shell has the following dimensions: length 6.2 mm.; height 5.5 mm.; diameter (left valves) 3.5 mm. Young shells are more orbicular than adults, and usually have a poorly defined lunule. Some shells, especially young ones, are more inflated than others, and have higher umbos and more

slender teeth. The sculpture is variable, but the radial threads are strongest at the ends of the shell.

The Bowden shells seem to be the same as living Porto Rican shells. *Gafrarium limonensis* Olsson,[1] described from Miocene beds in Costa Rica, is very similar.

Other localities.—Living, San Juan and Mayaguez Harbors, Porto Rico, in 5 to 30 fathoms.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 160061).

Genus CALLOCARDIA A. Adams.

Subgenus CALLOCARDIA s. s.

A. Adams, 1863, Annals and Magazine of Natural History, ser. 3, vol. 13, p. 307.

Type (by monotypy).—Callocardia guttata A. Adams. Recent, Seas of China and Japan.[2]

The following is a description of the subgenus *Callocardia* s. s.:

Shell small, thin, ovate, strongly inflated; lunule large, limited by a slightly depressed groove; sculpture consisting of concentric rugae; hinge of right valve consisting of 2 anterior lateral lamellae and 3 cardinals (3*a*, 1 and 3*b*); hinge of left valve consisting of an anterior lateral and 3 cardinals (2*a*, 2*b*, and 4*b*); anterior and posterior right cardinals (3*a* and 3*b*) joined and arching over middle cardinal (1); anterior and middle left cardinals (2*a* and 2*b*) similarly joined; posterior right and anterior left dorsal margins grooved to receive edge of opposite valve; pallial sinus shallow.

The Bowden species placed in this genus are very small, but the large number of shells representing them indicate that the largest are full grown. The left anterior lateral is more elongate than in *C. vesica,* and 3*a* and 3*b* are not so clearly joined.

Species of *Callocardia* first appeared in the Eocene seas. The living species are widely distributed in warm-temperate and tropical waters.

Key to the Bowden species of Callocardia s. s.

Umbos low, concentric rugae usually irregularly spaced..... *C. (C.) ammondea*
Umbos relatively high and full, concentric rugae uniformly spaced... *C. (C.) elethusa*

Callocardia (Callocardia) ammondea, new species.

(Plate 20, Figures 11, 12.)

Callocardia sp. indet., Dall. 1903 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1261.

The following is a description of this species:

Shell small, strongly inflated, slightly inequilateral, rounded-trigonal or broadly ovate; lunule large, limited by a shallow groove; sculpture consisting of irregularly spaced concentric rugae; anterior left cardinal long and narrow; right anterior (3*a*) and posterior (3*b*) cardinals obscurely joined; posterior right and anterior left dorsal margins grooved; anterior

[1] Comparison based on figures.

[2] I have not seen the type species. The description is based on *Callocardia vesica* (Dall), a living species from the Gulf of Mexico and the West Indies.

dorsal margin of some right valves, and ventral margin of some left and right valves, similarly grooved.

Length 7.5 mm.; height 7 mm.; diameter (left valve) 2.2 mm.

Some shells are more ovate and have stronger and more regular sculpture than the holotype. Alternating opaque and partly translucent concentric bands are visible on some specimens. All the American Miocene Callocardias heretofore described belong to the subgenus *Agriopoma,* which is characterized by large heavy valves, obscure right anterior lateral lamellae, and a deep angular pallial sinus.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352830).

Callocardia (Callocardia) elethusa, new species.

(Plate 20, Figures 13, 14.)

The following is a description of this species:

Shell small, strongly inflated, ovate; umbos high and full; lunule wide and long; sculpture consisting of closely and evenly spaced concentric rugae; hinge and inner edge of valve as in *Callocardia ammondea.*

Length 8.5 mm.; height 7.5 mm.; diameter (left valve) 2.5 mm.

The holotype is considerably larger than any other valve. This species is more inflated than *C. ammondea,* and has higher, fuller umbos, wider lunule, and more uniform sculpture.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352831).

Genus PITAR Römer.

Subgenus PITAR s. s.

Section PITAR s. s.

Römer, 1857, Kritische Untersuchung der Arten des Molluskengeschlechts Venus bei Linné und Gmelin, p. 15.

Type (by monotypy).—Venus tumens Gmelin. Recent, west coast of Africa.

The following is a description of the section *Pitar* s. s.:

Shell medium-sized, trigonal-ovate, strongly inflated; lunule wide, limited by a slightly depressed groove; escutcheon indistinct; sculpture consisting of incrementals; hinge of right valve consisting of 2 indistinct anterior lateral lamellae flanking a deep socket, and 3 cardinals, the anterior (3*a*) and middle (1) ones almost perpendicular to hinge-margin, the middle one heavy, the posterior one (3*b*) bifid; hinge of left valve consisting of a heavy anterior lateral and 3 cardinals, the anterior one (2*a*) resembling the right anterior cardinal (3*a*), the middle one (2*b*) very heavy and obscurely bifid, the posterior one (4*b*) slender and partly joined to the nymph; pallial sinus deep, its apex acutely angular.

There are no Bowden species of *Pitar* s. s.

Section HYPANTHOSOMA Dall.

Dall, 1902, Proceedings U. S. Nat. Mus., vol. 26, p. 354.

Type (by original designation).—Cytherea carbasea Guppy. Miocene, Jamaica.

The following is a description of the section *Hyphantosma:*

Shell resembling *Pitar* s. s., but the right anterior lateral lamellae are more prominent; the right posterior cardinal (3*b*) is very deeply bifid, separating it into two distinct parts; the left anterior lateral is not parallel to the hinge margin; the left middle cardinal (2*b*) is not grooved; and the left posterior cardinal (4*b*) is more distinctly separated from the nymph; sculpture consisting of zigzag grooves.

Hyphantosoma is a strictly American group, as fossil and living species are confined to the West Indies and adjoining waters. The earliest species is from beds of middle Oligocene age in Porto Rico. In other parts of the West Indies the earliest species is of Miocene age.

Pitar (Hyphantosoma) carbaseus (Guppy)

(Plate 20, Figures 15 to 19.)

Cytherea (*Circe*) *carbasea* Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 292, plate 18, fig. 13.

Callista carbasea (Guppy), Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 250.

Cytherea cabasea Guppy, Guppy, 1874, Geol. Mag. decade 2, vol. 1, p. 442 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531.

Pitaria (*Hyphantosoma*) *carbasea* (Guppy), Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1266. ? Hubbard, 1921, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 2, pp. 121–122, plate 16, fig. 2, New York Acad. Sci. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 422.

Pitaria (*Hyphantosoma*) n. sp., Toula, 1908, Jahrb. K. K. geol. Reichsanstalt, vol. 58, pp. 726–727, plate 28, fig. 16.

Pitar centangulata Brown and Pilsbry, 1911, Jour. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 369–370.

Pitaria carbasea (Guppy), Maury, 1917, Bull. Amer. Paleontology, vol. 5. p. 380.

The following is the original description of this species:

Shell rounded, rather inequilateral, tumid, sulcated by lines of growth decussating with numerous radiating striae, which divaricate on the anterior part of the disk, and become subrugose towards the posterior margin; lunule large, scarcely distinct; posterior margin rounded; anterior margin somewhat produced.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell medium-sized, thin, strongly inflated, ovate, moderately inequilateral; umbos full, strongly prosogyrate; lunule large, groove at its outer edge shallow except near lower margin; sculpture consisting of radial grooves, curved upward at ends of shell, zigzag in central part of shell; concentric wrinkles prominent at ends of shell; radial sculpture absent on lunule and umbo.

Length 39.5 mm.; height 32.5 mm.; diameter (right valve) 12.5 mm.

Specimens of this species in the Gabb collection from the Dominican Republic are smaller and have weaker concentric sculpture. A similar specimen was collected by the U. S. Geological Survey expedition from beds carrying a Cercado fauna modified by the first appearance

of Gurabo species. *P. centangulata,* from the Gatun formation, can hardly be separated. The holotype is worn, but has the shape and sculpture of *P. carbaseus,* although it is slightly less elongate and slightly more inflated.

Dall has commented on the progressive weakening of the characteristic sculpture in progressively younger species. *P. floridanus* Dall (Chipola formation), *P. opisthogrammatus* Dall (Caloosahatchee marl), and *P. simpsoni* Dall (living) are a series showing this feature. The zigzag sculpture is not noticeable on unworn shells of the living species. These species differ from *P. carbaseus* in outline and in having weaker sculpture.

Hubbard recorded as *P. carbaseus* poorly preserved casts from middle Oligocene beds in Porto Rico.

Other localities.—? San Sebastian shale, Lares limestone, and Cibao limestone (middle Oligocene), Porto Rico. Cercado formation (lower Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama Canal Zone.

Type material.—Holotype, British Museum (Natural History), Geological Department, No. 64086.

Subgenus HYSTEROCONCHA Fischer.

Section HYSTEROCONCHA s. s.

Fischer, 1887, Manuel de Conchyliologie, p. 1079.

Type (by monotypy).—Venus dione Linné. Recent, West Indies.

The following is a description of the section *Hysteroconcha* s. s.:

Shell medium-sized, ovate; lunule small, depressed; escutcheon long, narrow, limited by a wide depression; sculpture (of the type species) consisting of frilled concentric lamellae; on the posterior slope the lamellae are not frilled; at the edge of the posterior slope is a radial row of spines; a shorter row of smaller spines lies farther back on the posterior slope; hinge of right valve consisting of 2 low anterior lateral lamellae, and 3 cardinals, the anterior (3*a*) and middle (1) ones close together, the posterior one (3*b*) deeply bifid and joined to the anterior one (3*a*) by a thin plate; hinge of left valve consisting of a prominent anterior lateral, and 3 cardinals, the anterior one (2*a*) slender, the middle one (2*b*) heavy, the posterior one (4*b*) slender and obscurely bifid; inner edge of nymph having fine transverse granules; pallial sinus wide, moderately deep, apex broadly U-shaped.

The pallial sinus is much wider than in *Pitar* s. s., and the pallial line is closer to the margin of the shell.

The Bowden species, *Cytherea planivieta* Guppy, has been placed in the section *Lamelliconcha* Dall. The type of *Lamelliconcha, Cytherea concinna* Sowerby, a species living on the Pacific coast of Central America, has a slightly emarginate base, very deep, relatively narrow pallial sinus having a narrow asymmetric U-shaped apex; and the nymph has no granules. Despite the absence of an escutcheon

and the striking difference in sculpture the Bowden species seems to be more similar to *Venus dione*. The right anterior cardinal (3*a*) is undercut in both *Cytherea concinna* and in *Venus dione*, but not in *Cytherea planivieta*.

Externally the Bowden species closely resembles *Cytherea erycinoides* Lamarck, a Miocene species from Aquitaine. The right anterior (3*a*) and posterior (3*b*) cardinals of *Cytherea erycinoides* are not joined, its nymph has no granules, and its pallial sinus has a broad asymmetric V-shaped apex, the angle lying at the lower limb. This species is placed in the genus *Callista* Poli by French paleontologists, a name that Dall discards for *Macrocallista* Meek, on the ground that Poli's names are polynomial.

The living species of *Hysteroconcha* are characteristic of tropical American seas.

Pitar (Hysteroconcha) planivietus (Guppy).

(Plate 21, Figures 1 to 4.)

Cytherea (*Callista*) *planivieta* Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 292, plate 18, fig. 3.

Callista planivieta (Guppy), Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 250.

Cytherea planivieta Guppy, Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 442 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531. Not Grzybowski, 1899, Neues Jahrbuch, Beilage Band, vol. 12, p. 639, plate 19, fig. 3.

Pitaria (*Lamelliconcha*) *planivieta* (Guppy), Dall. 1903, Trans. Wagner Free Inst. Sci., Philadelphia, vol. 3, part 6, p. 1268. Not Spieker, 1922, Johns Hopkins Univ. Studies in Geology, No. 3, pp. 147–149, plate 10, fig. 6.

Pitaria planivieta (Guppy), Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 381, plate 63, fig. 3.

Macrocallista (*Chionella*) *planivieta* (Guppy), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 422.

The following is the original description of this species:

Shell inequilateral, transverse, oval, compressed; valves polished, ornamented with numerous flat, slightly irregular, concentric ribs, which are much closer than their interstices; umbones prominent, approximated; lunule scarcely impressed.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell large, polished, moderately inflated, very inequilateral, elongate-ovate; lunule small, depressed; sculpture consisting of coarse concentric rugae, on which microscopic striae are engraved; anterior lateral close to cardinals; right anterior cardinal (3*a*) not undercut; inner edge of nymph bearing transverse granules; pallial sinus wide, apex U-shaped.

Length 51 mm.; height 39.5 mm.; diameter (right valve) 10.5 mm.

This species is one of the most abundant veneroids. Its shape and regular sculpture are characteristic features. The granules on the nymph are most conspicuous on young shells. Specimens from the Cercado and Gurabo formations of the Dominican Republic closely

resemble Bowden shells, but are smaller and have a slightly wider posterior slope. Poorly preserved specimens of a similar *Pitar* from White Beach, Florida, are virtually indeterminable. The *Pitar* from the Zorritos formation of Peru, described by Grzybowski and Spieker, apparently represents a different species, as it is less elongate, and has higher umbos, heavier hinge, and more distant rugae.

Other localities.—Cercado formation (lower Miocene) and Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype, British Museum (Natural History), Geological Department, No. 64085.

Genus ANTIGONA Schumacher.

Subgenus ANTIGONA s. s.

Section ANTIGONA s. s.

Schumacher, 1817, Essai d'un Nouveau Système des Habitations des Vers Testacés, p. 154.

Type (by monotypy).—Antigona lamellaris Schumacher. Recent, Indo-Pacific.

The following is a description of the section *Antigona* s. s.:

Shell medium-sized, elongate ovate; lunule wide, limited by a deep groove; escutcheon long, excavated; sculpture consisting of distant concentric frills and wide radial threads frilling the lamellae; hinge of right valve consisting of 2 small lateral lamellae, and 3 cardinals, the anterior one (3*a*) thin and parallel to the hinge-margin, the posterior one (3*b*) wide and deeply bifid; hinge of left valve consisting of a small anterior lateral, and 3 cardinals, the anterior one (2*a*) obscurely bifid, the middle one (2*b*) deeply bifid; palial sinus shallow, V -shaped; ventral margin fluted along edge of lunule.

There are no Bowden species of *Antigona* s. s.

Subgenus VENTRICOLA Römer.

Section VENTRICOLA s. s.

Römer, 1867, Malakozoologische Bläter, Band 14, p. 115.

Type (by subsequent designation, Dall, 1902).—Venus rugosa Gmelin (=*Venus rigida* Dillwyn). Recent, West Indies.

The following is a description of the section *Ventricola* s. s.:

Shell reaching a moderately large size, orbicular-ovate, strongly inflated; lunule wide, deeply depressed; escutcheon flattened on left valve, absent on right; sculpture consisting of frilled concentric lamellae; hinge of right valve consisting of 2 low anterior lateral lamellae, and 3 heavy cardinals, the middle (1) and posterior (3*b*) ones bifid; hinge of left valve consisting of a small anterior lateral at base of hinge plate, and 3 cardinals, the anterior (2*a*) and middle (2*b*) ones heavy, the middle one bifid; pallial sinus shallow, its apex V-shaped; ventral margin of valve fluted, the fluting extending without interruption around edge of lunule.

The principal differences between *Ventricola* and *Antigona* s. s., are in details of the hinge. *Clausina* Brown (type, *Venus verrucosa*

Linné), considered synonymous with *Ventricola* by Cossmann, has no right anterior lateral lamellae, and only a rudimentary left anterior lateral. There seems to be no essential difference between *Ventricola* and *Ventricoloidea* Sacco (type, *Cytherea multilamella* Lamarck), which is represented by Oligocene, Miocene, Pliocene, and living species in southern Europe. The earliest American species is from the Red Bluff clay (lower Oligocene). The living species are most abundant in tropical waters, particularly in the West Indies, the west coast of Central America, and the Indo-Pacific region.

Antigona (Ventricola) blandiana (Guppy).

(Plate 21, Figures 5 to 9.)

Venus blandiana Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 3, pp. 85–86, plate 2, fig. 8. Guppy, 1874, Geol. Mag. decade 2, vol. 1, p. 436, plate 17, fig. 8, p. 442 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 530.

Cytherea (*Ventricola*) *blandiana* (Guppy), Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, p. 1277. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 424.

Antigona (*Ventricola*) *blandiana* (Guppy), Maury, 1917, Bull. Amer. Paleontology, vol. 5, pp. 381–382, plate 63, fig. 5. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 413, plate 30, figs. 5, 6.

The following is the original description of this species:

Suborbicular, subequilateral, moderately convex, adorned with numerous equidistant lamellae, between each of which there are about 7 or 8 concentric striae; somewhat angulate in front and subtruncate behind; margins crenate. Lunule smooth, impressed. Posterior dorsal area not defined, striae continuously with the lamellae of the disk. Umbones small. Cardinal teeth 2 under the lunule; lateral tooth 1, nearly halfway down the posterior slope.

Type locality.—Dominican Republic.

The following is a description of Bowden specimens of this species:

Shell moderately large, ovate, very inequilateral, strongly inflated; anterior dorsal margin short, slightly excavated, rounding abruptly into extended anterior end; posterior dorsal margin much longer, convex; posterior end almost vertically truncate; base decidedly arcuate; umbos full, strongly prosogyrate; lunule large, bounded by a deep groove; escutcheon flattened, limited by a broad fold; sculpture consisting of prominent recurved concentric lamellae, suppressed toward escutcheon, terminating at the boundaries of escutcheon and lunule, but continuing across them as incrementals; 3 to 7, the number increasing on the umbo, finer secondary lamellae lie between the primaries; hinge as described for the section.

Length 44.5 mm.; height 37 mm.; diameter (right valve) 15 mm.

This species is distinguished from the other veneroids by the prominent primary and secondary concentric lamellae. Adult shells are more elongate than young ones, and have thicker primary concentric lamellae and few secondary lamellae toward the ventral margin. On the largest shells an obscure ridge, at which the primary lamellae are

reduced, is visible a short distance from the ridge bounding the escutcheon.

The holotype of this species was collected at an unknown locality in the Dominican Republic. Later collections show that it is confined to the Gurabo formation. Bowden specimens are slightly less inflated and have lower and less inflated umbos. A broken valve from Curaçao seems to be this species. Olsson has described specimens from Costa Rica.

Broken valves from the Chipola formation of Florida have the same type of sculpture, but seem to be more rounded and less inflated. They probably belong to a different species represented by more complete, but poorly preserved, specimens from White Beach, Florida.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic, middle (?) Miocene, Curaçao,[1] Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 115548).

Genus CYCLINELLA Dall.

Dall, 1902, The Nautilus, vol. 16, p. 44.

Type (by subsequent designation, Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 357).—Dosinia tenuis Recluz. Recent, West Indies.

The following is a description of the genus *Cyclinella:*

Shell medium-sized, thin, suborbicular; lunule and escutcheon absent; sculpture consisting of incrementals; hinge of each valve consisting of 3 slender cardinals (3*a*, 1, 3*b*; 2*a*, 2*b*, 4*b*), the right posterior one (3*b*) deeply bifid; pallial sinus moderately wide and deep, steeply ascending, the apex narrowly U-shaped.

Cyclinella is the American representative of the European genus *Mysia* (called *Lucinopsis* by some writers), the right valve of which has only 2 cardinals. Guppy has described a species, *Dosinia cyclica,* from deposits of so-called Eocene age at Manzanilla, Trinidad. These deposits probably are Miocene. Aside from this doubtful record, the earliest species is of Miocene age.

Cyclinella plasiatenuis, new species.

(Plate 21, Figures 10, 11.)

The following is a description of this species:

Shell medium-sized, thin, suborbicular, subequilateral, moderately inflated; dorsal margins rounding evenly into lateral margins; anterior end slightly more extended than posterior; umbo full, strongly incurved, moderately high; sculpture consisting of irregular incrementals.

Length 24 mm.; height 24 mm.; diameter (left valve) 8mm.

C. plasiatenuis is known only from the holotype, an incomplete left valve. Only part of the lunule is preserved, but it apparently is rela-

[1] See footnote on page 25.

tively large and limited by a shallow groove. This species closely resembles the larger living *C. tenuis* (Recluz), but is more orbicular and has slightly more compressed teeth. *C. cyclica* (Guppy), a Miocene (?) species from Manzanilla, Trinidad, and *C. gatunensis* Dall, from the Gatun formation, are larger and less orbicular. *C. plasiatenuis* more closely resembles *C. beteyensis* Olsson,[1] a Miocene species from Costa Rica, but is smaller and more inflated.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352834).

Genus CHIONE Megerle von Mühlfeld.

Subgenus CHIONE s. s.

Section CHIONE s. s.

Mergerle von Mühlfeld, 1811, Gesellschaft naturforschender Freunde zu Berlin, Magazin für die neuesten Entdeckungen in der gesammten Naturkunde, year 5, p. 51.

Type (by subsequent designation, Gray, 1847).—Venus dysera Chemnitz (=*Venus cancellata* Linné). Recent, West Indies.

The following is a description of the section *Chione* s. s.:

Shell medium-sized, ovate, strongly inflated; lunule and escutcheon separated by absence of strong sculpture; sculpture consisting of upturned concentric lamellae, frilled by narrow radial ribs; hinge of right valve consisting of 3 cardinals, the anterior one (3*a*) slender, the others (1, 3*b*) heavy and obscurely bifid; hinge of left valve consisting of 3 cardinals, the middle one (2*b*) heavier than the others (2*a*, 4*b*) and having 2 obscure grooves; pallial sinus very shallow, its apex broadly V-shaped; ventral and anterior inner margins fluted.

Living and fossil species of *Chione* s. s. are confined to the West Indies, adjoining American waters, and the Pacific Ocean. The genus, which first appears in lower Miocene time, is very conspicuous in American tropical and subtropical Miocene and Pliocene faunas.

Key to the Bowden species of Chione s. s.

Radial ribs obscure..... *C. (C.) sawkinsi*
Radial ribs strong.
  Outline trigonal-ovate..... *C. (C.) woodwardi*
  Outline elongate-ovate..... *C. (C.) retugida*

Chione (Chione) sawkinsi, new species.

(Plate 21, Figures 12 to 14.)

Venus woodwardi Guppy, 1866 (part), Quart. Jour. Geol. Soc. London, vol. 22, p. 292, not plate 18, fig. 1. Guppy, 1874 (part), Geol. Mag. decade 2, vol. 1, p. 442 (list).

Chione woodwardi (Guppy), Dall, 1903 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1291–1292.

The following is a description of this species:

Shell medium-sized, ovate-trigonal, moderately inequilateral, strongly inflated; lower part of posterior margin obliquely truncate; lunule limited by a deep groove; escutcheon relatively narrow, bounded by a rounded ridge; margin of left valve adjacent to ligament raised along proximal two-

[1] Comparison based on figures.

thirds of its length; a short distance from this ridge lies a second lower ridge, which disappears toward the umbo, area between the two ridges slightly excavated and forming at margins the truncation; sculpture consisting of numerous concentric lamellae; over more than anterior half of shell their edges are thickened and turned toward the umbo, except near the lunule; on their ventral sides are low radial ribs, separated by interspaces of varying width; the ribs fail to extend across the interspaces, but alternate with broader and less distinct ribs on the shorter dorsal side of the lamellae; behind a radial line near middle of shell the edge of the lamellae is turned toward the ventral margin and is finely frilled; from the ends of each frill narrow low radials extend across at least the dorsal half of the interspaces; right anterior cardinal (3*a*) heavy, right middle cardinal (1) slender, right posterior cardinal (3*b*) distinctly bifid; left middle cardinal (2*b*) distinctly bifid; flutings of inner margin fine.

Length 25.5 mm.; height 22 mm.; diameter (right valve) 8 mm.

This species is one of the most abundant veneroids. Young shells are more rounded and their concentric lamellae may be frilled over the entire shell. The slight posterior truncation and the expanding and frilling of the concentric lamellae on the posterior half of the shell are characteristic features. The largest specimen has the following dimensions: length 33.8 mm.; height 28 mm.; diameter (right valve) 8.5 mm.

Although the type of *Venus woodwardi* is in the British Museum, 7 specimens in the Guppy collection (U. S. Nat. Mus. No. 115545) are labeled "types." All these shells represent the species here described as *Chione sawkinsi*. The same species is represented by a few specimens from the Cercado formation of the Dominican Republic that have fewer and coarser lamellae. *C. walli* (Guppy), from Trinidad, and *C. guppyana* Gabb, from the Dominican Republic, have more ribs on the ventral face of the lamellae than in the interspaces.

Other localities.—Cercado formation (lower Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 352836).

Chione (Chione) woodwardi (Guppy).

(Plate 22, Figures 1 to 4.)

Venus woodwardi Guppy, 1866 (part), Quart. Jour. Geol. Soc. London, vol. 22, p. 292, plate 18, fig. 1. Guppy, 1874 (part), Geol. Mag., decade 2, vol. 1, p. 442 (list).

Chione woodward (Guppy), Dall, 1903 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1291–1292. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 382, plate 63, fig. 6. ? Maury, 1920, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 1, pp. 40–41, New York Acad. Sci. ? Hubbard, 1921, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 2, p. 122, plate 13, fig. 7, New York Acad. Sci. Not *Venus woodwardi* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 530 (?=*Chione guppyana* Gabb).

The following is the original description of this species:

Shell subtrigonal, somewhat inequilateral, anteriorly rounded, posteriorly somewhat angulated; ornamented with numerous fine radiating costellae,

interrupted by equidistant concentric crenulate ridges, which are continued across the large lunule; margin beneath the lunule internally obsoletely toothed.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell medium-sized, high, rounded trigonal; lunule large, ornamented by continuations of concentric lamellae; escutcheon limited by an angular ridge; in front of posterior margin on ventral part of shell lies an obscure slightly depressed area, causing an obscure emargination on ventral margin; sculpture consisting of widely spaced concentric lamellae, frilled by strong radials extending across interspaces; the concentric ribs extend across the lunule, but are irregularly frilled; immediately behind lunule both radials and interspaces separating them are relatively broad; toward center of shell the radials retain their width or are slightly narrower, but the interspaces become narrower; the concentric lamellae stop abruptly at the ridge bounding the escutcheon; right (3*a*) and left (2*a*) anterior cardinals parallel to dorsal margin of shell, right middle cardinal (1) relatively heavy; fluting of inner margin relatively coarse.

Length 21 mm.; height 19.6 mm.; diameter (left valve) 7 mm.

The ventral posterior depressed area and accompanying emargination of the ventral margin are obscure and can not be detected on young shells. One or two of the broad anterior radials may be grooved. On some shells reduced concentric lamellae extend across the posterior ridge, and may even continue for a short distance across the escutcheon.

C. woodwardi has stronger and coarser radial ribs than *C. sawkinsi* and its concentric lamellae are more strongly frilled. Specimens from the Cercado formation of the Dominican Republic have slightly narrower ribs. Impressions of a *Chione* from the Quebradillas limestone of Porto Rico were called *C. woodwardi* by Maury and Hubbard. *C. woodwardi* closely resembles *C. tegulum* Brown and Pilsbry, from the Gatun formation, but is less inflated, and has a more extended posterior end and more extended concentric lamellae. It also resembles the living *C. cancellata* (Linné), but is smaller and has more numerous concentric lamellae.

Other localities.—Cercado formation (lower Miocene), Dominican Republic.

Type material.—Holotype; British Museum (Natural History), Geological Department, No. 64084.

Chione (Chione) retugida, new species.

(Plate 22, Figures 5, 6.)

The following is a description of this species:

Shell small, moderately inflated, elongate-ovate; groove bounding lunule shallow; escutcheon long and broad for size of shell, proximal half of its margin adjacent to ligament slightly raised; in front of ridge limiting

escutcheon surface of shell slightly depressed toward ventral margin, but not enough to affect margin; sculpture consisting of a moderate number of concentric lamellae and prominent rounded radials crossing the interspaces; near the lunule the edge of the concentric lamellae are turned toward the ventral margin and slightly frilled, but over remainder of anterior two-thirds of shell the edge is turned toward the umbo, thickened and the frills obscure or absent; on the posterior third, the edge is turned toward the ventral margin and frilled; obscure continuations of the lamellae extend across the lunule; right (3*a*) and left (2*a*) anterior cardinal parallel to dorsal margin of shell; left middle cardinal (2*b*) obscurely bifid.

Length 7 mm.; height 5.5 mm.; diameter (left valve) 1.5 mm.

Most of the valves are larger than the holotype, but are somewhat worn. The largest has the following dimensions: length 9.8 mm.; height 7 mm.; diameter 2.1 mm. The concentric sculpture resembles that of *C. sawkinsi.* As in *C. sawkinsi,* on small valves all the lamellae are frilled. On adult valves they are thickened and smooth over most of the anterior two-thirds. The radial ribs are similar to those of *C. woodwardi.*

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352837).

Section LIROPHORA Conrad.

Conrad, 1863, Proceedings Academy of Natural Sciences Philadelphia for 1862, pp. 575, 586.

Type (by subsequent designation, Dall, 1902).—Circumphalus (*Lirophora*) *athleta* Conrad (=*Venus latilirata* Conrad). Miocene and Pliocene, middle Atlantic states.

The following is a description of the section *Lirophora:*

Shell medium-sized, trigonal-ovate; lunule limited by a narrow deep groove; escutcheon flattened; sculpture consisting of very heavy thickened concentric lamellae; hinge of each valve consisting of 3 cardinals, the right anterior one (3*a*) paralleling dorsal margin of shell, the right middle one (1) subparallel to it, the left anterior one (2*a*) relatively heavy, the upper face of left middle one (2*b*) having two obscure grooves; right nymph and left posterior cardinal (4*b*) roughened; pallial sinus narrow, shallow; inner ventral and anterior margins finely fluted.

Aside from the striking difference in sculpture *Lirophora* differs from *Chione* s. s., in having a longer right anterior cardinal (3*a*), more compressed left anterior cardinal (2*a*), and narrower pallial sinus.

Externally *Lirophora* closely resembles some of the European Miocene species of *Clausinella,* but has a wider lunule and the inner margin of the lunule is frilled. The fossil and living species of *Lirophora* are confined to tropical and subtropical parts of the Atlantic and Pacific coasts of America. There are many species in the late Tertiary faunas of the West Indies and the adjacent mainland. The earliest species is recorded from the Byram marl (upper Oligocene) of Mississippi and middle Oligocene beds in Porto Rico.

Chione (Lirophora) hendersoni Dall.

(Plate 22, Figures 7 to 10.)

Venus paphia Guppy (not Linné), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 292. Guppy (part, not Linné), 1874, Geol. Mag., decade 2, vol. 1, p. 442 (list). Guppy (not Linné), 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 530.

Chione paphia Gabb (not Linné), 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 249.

Chione (*Lirophora*) *hendersonii* Dall, 1903, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 6, pp. 1295–1296, plate 55, fig. 22. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 383, plate 63, figs. 8, 9. ?Hubbard, 1921, Scientific Survey Porto Rico and Virgin Islands, vol. 3, part 2, pp. 122–123, New York Acad. Sci. Not Spieker, 1922, Johns Hopkins University Studies in Geology, No. 3, pp. 154–155.

Chione (*Lirophora*) *paphia* Pilsbry (not Linné), 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 423.

The following is the original description of this species:

Shell resembling the last species (*C. ballista* Dall), but with about 15 ribs, on the ventral bases of which the radial sculpture is represented by a series of punctuations which are rarely drawn out into striae; the ribs are closer together, sometimes obscuring the interspaces; the imaginary line at which the thick ribs suddenly become very thin and elevated marks off the posterior third of the shell, more than in any other species noted; the foliations are very thin and were presumably elevated, but are destroyed in all the specimens examined. In harmony with this arrangement of the sculpture the posterior end of the shell is somewhat rostrate; the lunule and escutcheon are wider than in *C. ballista;* the hinge normal, the teeth entire, the pallial sinus small and angular, and the adductor scars subequal.

Length of an average specimen 27.5, height 20.5, diameter 14.0 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell medium-sized, ovate-trigonal; lunule deeply depressed; escutcheon broad, bounded by a distinct ridge; sculpture consisting of 15 to 22 concentric lamellae, all except those on tip of umbo thickened and bent upward; along a radial line about three-fourths of distance from anterior end, edges of lamellae become thinner and continue to ridge bounding escutcheon; on this part of the shell the lamellae usually are broken; at anterior end the lamellae abruptly stop a short distance from narrow groove limiting lunule; ventral base of ribs obscurely or distinctly punctuate; between the ribs are incrementals that become more prominent toward anterior and posterior ends, and extend across lunule and escutcheon.

Length 33.5 mm.; height 27.5 mm.; diameter (left valve) 9 mm.

C. hendersoni is the most abundant veneroid. Some valves are more convex than others and have higher umbos, steeper posterior slope, more excavated anterior margin, and wider lunule and escutcheon. The average number of lamellae is 16 to 18. When the interspaces are wide, as a result of the reduction in the number of lamellae, 1 or 2 of the incrementals in the interspaces near the ventral margin may be emphasized.

The relatively large posterior area, over which the lamellae are thin-edged, is a characteristic feature. The contrast between the lamellae on this posterior area and on the rest of the shell is striking, as the thin-edged lamellae usually are broken. A small valve from the Cercado formation of the Dominican Republic seems to be this species. Specimens from the Gurabo formation are a little more elongate than Bowden specimens, and have a slightly wider lunule that is more deeply depressed near its edge, shorter left anterior cardinal, and more slender right anterior cardinal. Hubbard records this species from middle Oligocene beds in Porto Rico, but no figures are given. The *Chione* from the Zorritos formation of Peru, described by Spieker, is larger, less elongate, and has a shallower lunule and cruder sculpture.

There are several similar American Tertiary species, for example, *C. ballista* Dall from the Tampa formation of Florida, and *C. glyptocyma* Dall from the Oak Grove sand of Florida. The living West Indian species *C. paphia* (Linné) reaches a larger size, and has a more arcuate base and more closely appressed lamellae.

Other localities.—Cercado (lower Miocene), and Gurabo (middle Miocene) formation, Dominican Republic.

Type material.—5 cotypes (U. S. Nat. Mus. No. 115543).

Genus PARASTARTE Conrad.

Conrad, 1863, Proceedings Academy Natural Sciences Philadelphia for 1862, p. 288.

Type (by original designation).—Astarte triquetra Conrad. Miocene to Recent, Florida.

The following is a description of the genus *Parastarte:*

Shell small, trigonal-equilateral; umbos narrow; lunule large, not depressed, obscurely limited; escutcheon absent; sculpture consisting of incrementals; hinge of right valve consisting of a heavy middle cardinal (1), and small, slender anterior (3*a*) and posterior (3*b*) cardinals; hinge of left valve consisting of obscurely bifid anterior (2) and posterior (4*b*) cardinals; ligaments short; posterior end of pallial line flexed, but there is no distinct pallial sinus; inner ventral margin of valve finely fluted.

Parastarte triquetra is the only species of the genus heretofore described. It occurs in the Miocene and Pliocene deposits of Florida, and is living along the east and west coasts of Florida.

Parastarte antillensis, new species.

(Plate 22, Figures 11, 12.)

The following is a description of this species:

Shell small, narrow, high, trigonal, strongly inflated, subequilateral, anterior end slightly more extended; umbo high, full, slightly prosogyrate; sculpture consisting of incrementals; hinge of left valve consisting of 2 strong faintly bifid cardinals (2 and 4*b*), separated by a relatively broad and deep socket; inner margin of valve finely fluted, right valve not known.

Length 3.5 mm.; height 3.8 mm.; diameter (left valve) 1.5 mm.

Parastarte antillensis closely resembles *P. triquetra* Conrad, but is slightly larger and broader, and the apex of its umbo is narrower. It is known only from the holotype. There is a possibility that it is not a Bowden shell.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352839).

Family COOPERELLIDAE.

Genus COOPERELLA Carpenter.

Subgenus COOPERELLA s. s.

Carpenter, 1864, Report British Association for Advancement of Science for 1863, pp. 611, 639.

Type (by monotypy).—Oedalia (Cooperella) scintillaeformis Carpenter (=*Oedalia subdiaphiana* Carpenter). Pleistocene and Recent, California.

The following is a description of the subgenus *Cooperella* s. s.:

Shell small, thin, ovate, moderately inequilateral, moderately inflated; hinge of right valve consisting of 2 thin cardinals (3*a* and 3*b*), the posterior one (3*b*) bifid; hinge of left valve consisting of 3 thin cardinals (2*a*, 2*b*, 4*b*), the middle one (2*b*) divided to form an inverted ; resilium seated on a narrow depressed area behind cardinals and separated from them by a thin plate; pallial sinus deep, wide, its apex U-shaped.

The living species of *Cooperella* s. s. are confined to the Pacific coast of America, but Dall has described a Miocene species from the middle Atlantic states.

Subgenus COOPERELLOPSIS, new subgenus.

Type.—Cooperella (Cooperellopsis) thaumasta, new species.

The following is a description of the subgenus *Cooperellopsis:*

Shell small, thin, subequilateral, subrectangular, strongly inflated; umbos high, wide; sculpture consisting of incrementals; hinge of left valve resembling *Cooperella* s. s., but the middle cardinal (2*b*) is obscurely bifid; pallial sinus obscure; right valve not known.

Aside from the striking difference in outline *Cooperellopsis* differs from *Cooperella* s. s. in having an obscurely bifid, instead of deeply bifid, left middle cardinal (2b).

Cooperella (Cooperellopsis) thaumasta, new species.

(Plate 22, Figures 13 to 15.)

The following is a description of this species:

Shell small, thin, rounded subquadrate, subequilateral, greatly inflated; anterior margin broadly rounded, posterior margin obliquely subtruncate, median part of base almost straight; umbo high, broad, full; surface bearing a few obscure irregularly spaced incrementals; ligament area short, resilium area short, moderately depressed, largely external, both placed behind cardinals; hinge of left valve consisting of 3 diverging cardinals, anterior (2*a*) and posterior (4*b*) ones compressed, middle one (2*b*) larger, triangular and obscurely bifid; pallial sinus obscure; right valve not known.

Length 7.5 mm.; height 7.2 mm.; diameter (left valve) 3.5 mm.

This species, which is represented by the holotype, a left valve, is remarkable for its extreme inflation, the diameter almost equaling the length or height.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352840).

Superfamily TELLINACEA.

Family TELLINIDAE.

Genus TELLINA Linné.

Subgenus TELLINA s. s.

Section TELLINA s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 674.

Type (by subsequent designation, Gray, 1847).—Tellina radiata Linné. Recent, West Indies.

The following is a description of the section *Tellina* s. s.:

Shell relatively large, elongate-ovate; base emarginate near posterior end, a shallow depression extending from the emargination toward the umbo; sculpture consisting of incrementals and obscure radial markings; hinge of right valve consisting of a slender anterior cardinal (3*a*), a heavy bifid posterior cardinal (3*b*), and distinct anterior and posterior lateral lamellae; hinge of left valve consisting of a deeply bifid anterior cardinal (2), a smaller posterior cardinal (4), and obscure anterior and posterior lateral lamellae; pallial sinus extraordinarily deep, its apex asymmetrically U-shaped, almost touching anterior muscle-scar, confluent with pallial line, lower limb of sinus joining pallial line at middle of shell.

Tellina virgata Linné usually is given as the type species because it is the only species listed by Lamarck in the Prodrome. Tellinas of the group of *T. radiata* are called *Liotellina* Fischer, which has the same type.

There are no species of *Tellina* s. s. in the Bowden formation.

Section MOERELLA Fischer.

Fischer, 1887, Manuel de Conchyliologie, p. 1147.

Type (by monotypy).—Tellina donacina Linné. Recent, seas of Europe.

The following is a description of the section *Moerella:*

Shell medium-sized, inflated, elongate-ovate, inequilateral, posterior end obscurely rostrate; sculpture consisting of concentric rugae; right anterior (3*a*) and left posterior (4) cardinals very small; right laterals strong, anterior one closer to cardinals; left laterals weaker, anterior one weaker than posterior; pallial sinus almost touching anterior adductor scar, confluent with pallial line, its apex U-shaped.

The left anterior lateral is weaker than in *Tellina* s. s. The Tertiary and living species of *Moerella,* all of which are relatively small, are widely distributed.

Key to the Bowden species of Moerella.

Posterior end obscurely rostrate..... *T. (M.) simpsoni*
Posterior end not rostrate..... *T. (M.) hendersoni*

Tellina (Moerella) simpsoni Dall.

(Plate 23, Figures 1 to 3.)

Tellina (*Moerella*) *simpsoni* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1024, plate 46, fig. 12.

The following is the original description of this species:

Shell small, inflated, equivalve, very inequilateral, polished; anterior dorsal slope rectilinear, anterior end rounded, base convexly arcuate; posterior end very short with the extremity bluntly pointed; beaks low, somewhat opisthogyrous, with a perceptible lunule; hinge normal, pallial sinus extending nearly to the anterior adductor scar, mostly confluent below. Long. 7, alt. 5, diam. 4 mm.

Type locality.—Bowden, Jamaica.

T. (*M.*) *simpsoni* is distinguished by its very inequilateral outline, convexity and slight posterior rostrum. Some valves are sculptured with fine concentric striae.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135697).

Tellina (Moerella) hendersoni Dall.

(Plate 23, Figures 4 to 7.)

Tellina (*Moerella*) *hendersoni* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, pp. 1024–1025, plate 46, fig. 5.

The following is the original description of this species:

Shell small, moderately convex, very inequilateral; resembling the preceding species *T. simpsoni* but less inflated, more regular, with posterior end not constricted or markedly flexed; surface polished, with, except near the beaks, fine, rather distant, concentric threads, which on the basal half of the posterior end rise into extremely delicate low lamellae; hinge normal, strong; pallial sinus connecting the adductor scars and confluent below; there is a slightly impressed narrow lunule. Lon. 7.5, alt. 4, diam. 3 mm.

Type locality.—Bowden, Jamaica.

This species, which is abundant, closely resembles *T. simpsoni,* but its posterior end is not rostrate. One of the largest valves of *T. hendersoni* has the following dimensions: length 8 mm.; height 6 mm.; diameter 2 mm. The largest valve of *T. simpsoni* has the following dimensions: length 6.5 mm.; height 5 mm.; diameter 2 mm. Most valves of *T. hendersoni* are less inflated than those of *T. simpsoni,* but some are as strongly inflated. *T. aclontea* Dall, from the Chipola formation of Florida, is smaller, less inflated, and more elongate.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135696).

Section EURYTELLINA Fischer.

Fischer, 1887, Manuel de Conchyliologie, p. 1147.

Type (*by monotypy*).—*Tellina punicea* Born. Recent, Pacific coast of northern South America.

The following is a description of the section *Eurytellina:*

Shell medium-sized, elongate-ovate, subequilateral; posterior end not rostrate, but a narrow flattened area lies at the posterior end; sculpture consisting of concentric rugae; right anterior cardinal (3*a*) relatively heavy, right laterals strong, anterior one close to the cardinals, posterior one distant; left posterior cardinal (4) small and very slender, left laterals not so strong as right ones, resembling them in position; pallial sinus touching anterior adductor, wholly confluent with pallial line.

The small, slender left posterior cardinal (4) and the position of the laterals are characteristic features of this section, which is extensively represented in Tertiary and present faunas.

Key to the Bowden species of Eurytellina.

Nymph relatively short, thick.
  Length exceeding 10 mm.
    Shell heavy, sculpture strong..... *T.* (*E.*) species
    Shell thin, sculpture weak..... *T.* (*E.*) *spiekeri*
  Length not exceeding 8 mm.
    Shell distinctly rostrate..... *T.* (*E.*) *pharicda*
    Shell not distinctly rostrate..... *T.* (*E.*) *gonida*
Nymph long, slender.
  Shell subequilateral, moderately inflated..... *T.* (*E.*) *halistrepta*
  Shell inequilateral, strongly inflated
    Shell distinctly rostrate..... *T.* (*E.*) *apomsa*
    Shell not distinctly rostrate..... *T.* (*E.*) *browni*

Tellina (Eurytellina) species.
(Plate 23, Figures 8, 9.)

Tellina (*Eurytellina*) sp., Dall, 1900 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1024.

Two broken right valves in the U. S. National Museum collection represent a medium-sized *Eurytellina.* The most striking feature of this species is the short, thick nymph, which ends abruptly at its posterior end, thus affecting the outline of the dorsal margin.

Spieker considered *T. aequicincta* Spieker, from the Zorritos formation of Peru, the same species. The holotype from Zorritos has a slender nymph, and the concentric rugae at the posterior end are less foliaceous. Specimens from Bowden and Zorritos have essentially the same outline and the same plan of sculpture.

Tellina (Eurytellina) spiekeri, new species.
(Plate 23, Figures 10, 11.)

Tellina (*Angulus*) *pressa* Dall, 1900 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1026.

The following is a description of this species:

Shell small, thin, moderately inflated, inequilateral, posterior end not rostrate; sculpture consisting of obscure concentric rugae; nymph short, thick; right anterior lateral stronger than posterior and closer to cardinals; hinge of left valve not known; pallial sinus touching anterior adductor scar, wholly confluent with pallial line.

Length 11.5 mm.; height 6.5 mm.; diameter (right valve) 1.5 mm.

This species closely resembles *T. pressa* Dall, from the Chipola formation of Florida, but has less distinct sculpture. The *Tellina* from

the Zorritos formation of Peru called *T. pressa* by Spieker has a more slender nymph, shorter right anterior lateral, and stronger sculpture.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352843).

Tellina (Eurytellina) pharcida Dall.

(Plate 23, Figures 12 to 15.)

Tellina (Angulus) pharcida Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1025, plate 46, fig. 7.

The following is the original description of this species:

Shell small, elongate, very inequilateral, moderately convex; anterior end produced, rounded; posterior end short, roundly pointed, with a slight flexure; beaks in the posterior third; surface covered with extremely fine close-set grooves; sculpture as usual a little stronger near the posterior end; beaks low, pointed; lunule obsolete; hinge normal, pallial sinus obscure in the polish of the interior but probably normal; no thickened rays. Lon. 5.5, alt. 3, diam. 1.5 mm.

Type locality.—Bowden, Jamaica.

This species has a distinct right posterior lateral and therefore is not an *Angulus* (type, *Tellina lanceolata* Linné). Its long right anterior lateral close to the cardinals, and its very small left anterior cardinal suggest that it is a small *Eurytellina,* although it is more inequilateral than the type species, and its posterior end is clearly rostrate. The nymph is short and thick.

It resembles the Miocene and Pliocene species *T. umbra* Dall, but is smaller and more inflated.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135706).

Tellina (Eurytellina) gonida, new species.

(Plate 23, Figures 16, 17.)

The following is a description of this species:

Shell small, elongate, uniformly inflated, very inequilateral; posterior rostrum scarcely differentiated from general convexity of shell; sculpture consisting of fine concentric rugae, some of which are slightly lamellar at posterior end; laterals absent on left valve, left posterior cardinal (4) very small; nymph short, thick; pallial sinus obscure; right valve not known. Length 7.5 mm.; height 4.5 mm.; diameter (left valve) 1.7 mm.

Although this species has no recognizable left laterals it seems to be a *Eurytellina.* It is very similar to *T. pharcida* Dall, but is slightly higher and has no distinct posterior rostrum.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352844).

Tellina (Eurytellina) halistrepta Dall.

(Plate 23, Figure 18.)

Tellina (Phyllodina) halistrepta Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1023, plate 47, fig. 17.

The following is the original description of this species:

Shell compressed, flattish, subequilateral, longer than high; beaks small, low, resembling a pustule on the summit of the broad smooth nepionic

shell; surface marked anteriorly with rather close, low, elevated, concentric threads with about equal interspaces; near the posterior third of the disk these threads become less numerous by the cessation of alternate threads, making the interspaces wider, while the persistent threads become lamellose; in the type, which is a young shell, the dorsal margin is not coronate, but in the adult there are probably dorsal scales corresponding to the later lamellae; hinge normal for the section, pallial line obscure. Lon. 9, alt. 5.5, diam. 1.2 mm.

Type locality.—Bowden, Jamaica.

The holotype, a right valve, is the only specimen of this species. It lacks the sculpture and narrow depressed posterior area of *Phyllodina* (type, *Tellina squamifera* Deshayes). *Phyllodina* has no recognizable left posterior lateral; its pallial sinus is free and ascending, resembling that of *Arcopagia* (type, *Tellina crassa* Pennant). Cossmann considers *Arcopagia* a separate genus on account of its free ascending pallial sinus. *T. halistrepta* probably is a *Eurytellina.* The holotype is glued on a card and its interior is inaccessible.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135704).

Tellina (Eurytellina) apomsa, new species.

(Plate 23, Figures 19, 20.)

The following is a description of this species:

Shell small, elongate, moderately inflated, very inequilateral; posterior end distinctly rostrate, area in front of it slightly depressed, obscurely emarginating base; sculpture consisting of concentric rugae, becoming slightly lamellar on posterior depressed area; right posterior lateral weak; nymph long, slender; pallial sinus obscure; left valve not known.

Length 6 mm.; height 4 mm.; diameter (right valve) 1.2 mm.

T. (*E.*) *apomsa* is known from 2 right valves. The strong, regular sculpture is the most characteristic feature. Aside from the greater prominence of the sculpture, it is distinguished from *T. pharcida* and *T. gonida* by its greater inflation, greater height, less extended posterior end, stronger rostrum, and longer nymph.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352845).

Tellina (Eurytellina) browni, new species.

(Plate 23, Figures 21, 22.)

Tellina (*Eurytellina*) sp., Dall, 1900 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1024.

The following is a description of this species:

Shell small, thin, elongate, moderately inflated, inequilateral; posterior end obscurely rostrate, a broad flattened area lies behind the rostrum; sculpture consisting of weak concentric rugae, some of which become lamellar at posterior end; right laterals strong; the left valve has an

obscure posterior lateral, but no anterior one; nymph long, slender; pallial sinus obscure.

Length 7.8 mm.; height 4.5 mm.; diameter (right valve) 1.5 mm.

This species is represented by 2 left and 1 right valve. It is less inequilateral than *T. apomsa* and has no distinct rostrum. Its sculpture is similar to that of *T. halistrepta* Dall, but the shell is more inequilateral and more elongate.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352846).

Section MERISCA Dall.

Dall, 1900, Proceedings U. S. Nat. Mus., vol. 23, p. 290.

Type (by original designation).—Tellina crystallina Wood. Recent, West Indies and Pacific coast of Central America.

The following is a description of the section *Merisca:*

Shell small, trigonal-ovate, posterior end strongly rostrate, base emarginate in front of rostrum; sculpture consisting of distant, thin, concentric lamellae; hinge resembling *Tellina* s. s., but the left laterals are absent; pallial sinus very deep, almost touching anterior adductor scar, confluent with pallial line along virtually its entire length.

Merisca is separated from the preceding sections by the absence of left laterals. The living species inhabit the warm-temperate and tropical seas.

Key to the Bowden species of Merisca.

Shell relatively large, length exceeding 10 mm..... *T.* (*M.*) species
Shell small, length less than 10 mm.
Radial sculpture absent..... *T.* (*M.*) *sclera*
Shell moderately inflated, not distinctly rostrate..... *T.* (*M.*) *sclera sclera*
Shell strongly inflated, distinctly rostrate..... *T.* (*M.*) *sclera lerasca*
Radial sculpture present..... *T.* (*M.*) *acrocosmia*

Tellina (Merisca) species.

Tellina (*Merisca*) *aequistriata* Dall, 1900 (part, not Say), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1020.

Two broken right valves are similar to the Miocene and living species *Tellina* (*Merisca*) *aequistriata* Say, but are more elongate and more inequilateral, and have finer sculpture and heavier right posterior cardinal. This species is much larger than the other Bowden species of *Merisca.*

Tellina (Merisca) sclera sclera Dall.

(Plate 24, Figures 1 to 4.)

Tellina (*Merisca*) *sclera* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1021; part 6, plate 49, fig. 5.

The following is the original description of this subspecies:

Shell minute, short, plump, with low inflated beaks, rounded in front and below, shorter and blunt behind; slightly flexed, not rostrate, but with an

obsolete radial sulcus in the right valve; sculpture of elevated crowded concentric threads, becoming alternately obsolete towards the ends of the shell where the persistent threads are more elevated and tend to become lamellose; hinge normal, strong for the size of the shell; pallial sinus short, round, confluent below. Lon. 4.2, alt. 3.2, diam. 2 mm.

Type locality.—Bowden, Jamaica.

The largest valve has the following dimensions: length 5.2 mm.; height 3.8 mm.; diameter 1.5 mm. The posterior rostrum is obscure in this subspecies.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135698).

Tellina (Merisca) sclera lerasca, new subspecies.

(Plate 24, Figures 5, 6.)

The following is a description of this subspecies:

Shell small, moderately inequilateral, greatly inflated; posterior end obscurely rostrate, base slightly emarginate in front of rostrum; umbo full, low, broad, placed nearer posterior end; sculpture as in *T.* (*M.*) *sclera sclera,* but the concentric lamellae are less conspicuous near the posterior end; hinge heavy for size of shell.

Length 5 mm.; height 4 mm.; diameter (left valve) 2 mm.

The left valve on which this subspecies is based is much more inflated and less inequilateral than *T. sclera sclera,* and has a more distinct posterior rostrum.

Type material—Holotype (left valve, U. S. Nat. Mus. No. 352848).

Tellina (Merisca) acrocosmia Dall.

(Plate 24, Figures 7 to 10.)

Tellina (*Merisca?*) *acrocosmia* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, pp. 1020–1021, plate 46, fig. 10.

The following is the original description of this species:

Shell small, rounded, triangular, with nearly central inconspicuous beaks, and hardly pointed, slightly flexed, posterior end, the anterior end evenly rounded, base convexly arched; lunule obsolete; disk covered with a fine radial threading, more or less concealed by fine, elevated, concentric sharp lamellae; hinge normal, teeth large and strong for the size of the shell; pallial sinus large, nearly reaching the anterior adductor scar, largely confluent below; above rising above the level of the posterior adductor. Lon. 7, alt. 5.5, diam. 3 mm.

Type locality.—Bowden, Jamaica.

This species is one of the most abundant species of *Tellina.* The fine radial threads frill the thin concentric lamellae. The posterior end is not so strongly rostrate as in the type species of the section.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135699).

Section SCISSULA Dall.

Dall, 1900, Proceedings U. S. Nat. Mus., vol. 23, p. 291.

Type (by original designation).—Tellina decora Say. Recent, Florida.

The following is a description of the section *Scissula:*

Shell medium-sized, elongate ovate, moderately inflated, posterior end not distinctly rostrate; sculpture consisting of concentric rugae, crossed by oblique rugae in central part of shell, at the posterior end the rugae become slightly lamellar; nymph thick; right anterior lateral very broad, bent upward, right posterior lateral very small, much farther from cardinals than anterior one; left posterior lateral small, but distinct, anterior one absent; left anterior dorsal margin indented opposite right anterior lateral; pallial sinus almost touching anterior adductor scar, confluent with pallial line, its apex broadly U-shaped.

The anterior end of the right anterior lateral is very broad and bent upward in the type species. The position of the right laterals with reference to the cardinals is the same as in *Eurytellina,* but the posterior one is much less distinct. The oblique sculpture is a striking feature.

Fossil and living species of *Scissula* seem to be confined to the West Indies and adjoining waters, the Pacific coast of Central and southern North America, and the Pacific. The earliest American species is of lower Miocene age.

Tellina (Scissula) healyi, new name.

(Plate 24, Figures 11 to 13.)

Tellina (Scissula) scitula Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1028, plate 47, fig. 15. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 389, plate 64, fig. 12.

Not *Tellina scitula* Meek and Hayden, 1857, Proc. Acad. Nat. Sci. Philadelphia for 1856, p. 82.

The following is the original description of this species:

Shell small, thin, elongate-ovate, polished, inequilateral; rounded in front, moderately pointed behind; beaks low, surface with fine, regular, rather close striae extending obliquely backward towards the base, with more or less evident microscopic radial striation; posterior dorsal areas minutely concentrically waved; interior with no thickened rays; hinge normal, very delicate; pallial sinus long, high, normal. Lon. 8, alt. 4.2, diam. 1.5 mm.

Type locality.—Bowden, Jamaica.

This small species resembles the small species of *Eurytellina* in almost all features except the oblique sculpture. It is remarkably similar to *T. (E.) gonida.* The right anterior lateral is long and slender like in the species of *Eurytellina;* the right posterior lateral is small, but distinct. The nymph is short and thick. Specimens from the Cercado formation of the Dominican Republic have a thinner shell and more slender nymph.

Other localities.—Cercado formation (lower Miocene), Dominican Republic.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135707).

Subgenus ELLIPTOTELLINA, Cossmann.

Crossmann, 1886 ,Catalcgue Illustré des Coquilles Fossiles de l'Eocène des Environs de Paris, part 1, p. 58.

Type (by original designation).—Donax tellinella Lamarck. Eocene, Paris Basin.

The following is a description of the subgenus *Elliptotellina:*

Shell small, elongate-elliptical, moderately inequilateral, posterior end not distinctly rostrate, both ends rounded; sculpture consisting of fine concentric rugae; right laterals prominent, posterior one closer to cardinals and shorter than anterior one; left laterals less distinct; nymph short, heavy; pallial sinus free, moderately deep, slightly ascending, its apex U-shaped.

The free, slightly ascending pallial sinus separates *Elliptotellina* from the subgenus *Tellina* s. s. The short, heavy nymph, the hinge, and the free slightly ascending sinus suggest that *T. cymobia* is an *Elliptotellina,* although it has distinct radial sculpture. At first glance this species looks like a small *Psammobia*-like shell, such as *Asaphis,* but its laterals and free sinus exclude it from the family Psammobiidae.

The geologic history of *Elliptotellina* is discussed under the following species.

Tellina (Elliptotellina) cymobia, new species.

(Plate 24, Figures 14 to 16.)

The following is a description of this species:

Shell small, obscurely wedge-shaped, posterior part slightly more inflated than anterior; concentric sculpture consisting of distant rugae, radial sculpture of posterior part consisting of distant obscurely beaded ribs, remainder of shell having obscure radial striae; right posterior lateral slightly shorter than anterior; left laterals distinctly projecting from margin of shell; pallial sinus free, slightly ascending, reaching beyond middle of the shell, its apex broadly U-shaped; posterior margin of shell slightly serrate, due to radial ribs.

Length 8 mm.; height 4.5 mm.; diameter (left valve) 2 mm.

The obscure wedge-like outline gives this species the appearance of an elongate *Donax.* No similar American Tertiary species has been described. In Europe *Elliptotellina* is confined to Eocene deposits. *T. cymobia* may belong to a different group, but it has the essential features of the type species. In general features it resembles *T.* (*E.*) *americana* Dall, a living species from the middle Atlantic coast of the United States, but has stronger radial sculpture. It is much more similar to the living Pacific coast (Panama Bay to the Galapagos

Islands) species *T. pacifica* Dall, differing principally in details of sculpture. These two species are the only living American species.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352850).

Genus STRIGILLA Turton.

Section STRIGILLA s. s.

Turton, 1822, Conchylia Insularum Britannicarum, p. 117.

Type (by subsequent designation, Gray, 1847).—Tellina carnaria Linné. Recent, Hatteras southward to Brazil.

The following is a description of the section *Strigilla* s. s.:

Shell medium-sized, ovate-trigonal; sculpture consisting of divaricating rugae; on the anterior part of the shell they are bent upward, then downward, these rugae are replaced in the central part of the shell by very oblique, more closely spaced rugae, meeting at an acute angle oblique rugae on the posterior end; hinge of right valve consisting of a slender anterior cardinal (3*a*), a heavier bifid posterior cardinal (3*b*), and heavy anterior and posterior laterals, the posterior one farther from the cardinals; hinge of left valve consisting of a slender bifid anterior cardinal (2), a slender posterior cardinal (4) and relatively strong anterior and posterior laterals; pallial sinus wholly confluent with pallial line, uniting adductor scars by a wavy line convex downward near anterior end and convex upward near posterior end.

The living species of *Strigilla* are confined to tropical and subtropical West Indian, West African and Pacific waters.

Strigilla (Strigilla) pisiformis (Linné).

(Plate 24, Figures 17, 18.)

Tellina pisiformis Linné, 1758, Syst. Nat., ed. 10, p. 677. Hanley, 1847, Thes. Conch., *Tellina,* p. 261, plate 51, fig. 30.

Cardium discors Montagu, 1803, Test. Brit., p. 84.

Strigilla pisiformis (Linné), Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 249. Dall, 1900, Proc. U. S. Nat. Mus., vol. 23, p. 298. Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, pp. 1038–1039. Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, part 1, p. 482. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 389, plate 65, fig. 6. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 426. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, pp. 426–427.

The following is a description of Bowden specimens of this species:

Shell small, trigonal-ovate, strongly inflated, inequilateral; umbos full, broad, high, placed nearer anterior end; sculpture consisting of oblique rugae that are slightly bent upward at anterior end, and near posterior end meet at an angle more obscure oblique rugae; left posterior cardinal (4) very slender; anterior laterals closer to the cardinals than posterior.

Length 7.5 mm.; height 6.5 mm.; diameter (right valve) 2.5 mm.

On some valves the closely spaced rugae at the posterior end are angulated before meeting the coarser rugae that sculpture the central part of the shell. Young shells are more orbicular than adults. The largest valve has the following dimensions: length 9.5 mm.; height 8.5 mm.; diameter 2.7 mm.

Bowden specimens run a little smaller than Recent ones, and are a little more inequilateral, and have higher and fuller umbos.

Other localities.—Cercado formation (lower Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica. Living, Hatteras southward through the West Indies.

Genus MACOMA Leach.

Subgenus MACOMA s. s.

Leach, 1819, in John Ross, A voyage of discovery made under the orders of the Admiralty in His Majesty's ships *Isabella* and *Alexander* for the purpose of exploring Baffins Bay and inquiring into the probability of a north-west passage, Appendix II, p. LXII.

Type (*by monotypy*).—*Macoma tenera* Leach (=*Tellina calcarea* Gmelin). Recent, northern seas of Europe and North America.

The following is a description of the subgenus *Macoma* s. s.:

Shell medium-sized, elongate-ovate, inequilateral; sculpture consisting of incrementals; hinge of right valve consisting of a slender anterior cardinal (3*a*) and a widely and deeply bifid posterior cardinal (3*b*); hinge of left valve consisting of a widely and deeply bifid anterior cardinal (2) and a slender posterior cardinal (4); pallial sinus deep, confluent with pallial line along about half its length, its apex U-shaped.

There are no Bowden species of *Macoma* s. s., which live in boreal and temperate seas.

Subgenus PSAMMACOMA Dall.

Section PSAMMACOMA s. s.

Dall, 1900, Proceednigs U. S. Nat. Mus., vol. 23, p. 292.

Type (*by original designation*).—*Tellina candida* Lamarck. Recent, Indo-Pacific.

The following is a description of the section *Psammacoma:*

Shell medium-sized, elongate-ovate, inequilateral; sculpture consisting of incrementals; hinge resembling *Macoma* s. s.; pallial sinus moderately deep, confluent with pallial line along about half its length, its apex broadly U-shaped.

Psammacoma, which lives in the tropical seas, is more elongate than *Macoma* s. s., and the lower limb of its pallial sinus rises more steeply. The earliest species is recorded from lower Miocene deposits.

Key to the Bowden species of Psammacoma s. s.

Shell very elongate, posterior end conspiciously extended..... *M.* (*P.*) *tracta*
Shell moderately elongate, posterior end not conspicuously extended.. *M.* (*P.*) *olivella*

Macoma (Psammacoma) tracta Dall.

(Plate 24, Figure 19.)

Macoma (*Psammacoma*) *tracta* Dall, 1900 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1053, plate 47, fig. 13.

The following is the original description of this species:

Shell small, thin, rather compressed, elongated, inequilateral, the anterior end longer; beaks low, not conspicuous; posterior end slightly flexed to the

right; anterior end higher, rounded, posterior attenuated, bluntly terminated; surface smooth, except for faint incremental lines; interior (inaccessible in the specimens). Lon. 12.7, alt. 5, diam. 2 mm.

Type locality.—Bowden, Jamaica.

This species is represented by the holotype, a small right valve, and a larger left valve that has the following dimensions: length 22 mm.; height 10 mm.; diameter about 2.5 mm. It is more elongate than the other Bowden species, *M. olivella* Dall, and its posterior end is more extended. It resembles *M. yaquensis* Maury, a species from the Cercado formation of the Dominican Republic, but is more elongate and more inequilateral.

Specimens from the Chipola formation of Florida, referred to *M. tracta,* are no longer in the U. S. National Museum. Broken specimens from the Shoal River formation labeled *M. tracta* represent a new species described by Gardner (Ms.).

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135702).

Macoma (Psammacoma) olivella Dall.

(Plate 24, Figures 20, 21.)

Macoma (*Psammacoma*) *olivella* Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1054, plate 47, fig. 20.

The following is the original description of this species:

Shell large, solid, moderately convex, with rather full, conspicuous beaks, equivalve, very inequilateral; anterior dorsal slope rectilinear, anterior end rounded; posterior dorsal slope slightly concave, posterior end much shorter, rounded below, blunt terminally and subangulate at its junction with the dorsal line; an elongated lunule and escutcheon, moderately impressed and not very definitely limited, are present; surface smooth, except for lines of growth and on the ridge bounding the lunule, which is slightly undulated, especially near the beaks; hinge normal, teeth rather small, pallial sinus gibbous, short, partly free below. Lon. 23, alt. 13, diam. 5 mm.

Type locality.—Bowden, Jamaica.

This species is known only from the holotype, a broken right valve.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135708).

Subgenus CYMATOICA Dall.

Dall, 1900, Proceedings U. S. Nat. Mus., vol. 23, p. 292

Type (*by original designation*).—*Tellina undulata* Hanley. Recent, Pacific coast of Central America.

The following is a description of the subgenus *Cymatoica:*

Shell small, thin, elongate, ovate, posterior end rostrate; sculpture consisting of coarse, concentric or slightly oblique waves; hinge resembling *Macoma* s. s., the right anterior cardinal (3*a*) relatively heavy; pallial sinus moderately deep, U-shaped, confluent with pallial line along less than half its length.

Cymatoica, characterized by its small, thin rostrate shell, and coarse sculpture, is a tropical American group represented by living species in the West Indies and on the Pacific coast of Central America. The earliest species is of lower Miocene age.

Macoma (Cymatoica) vendryesi Dall.

(Plate 24, Figures 22 to 24.)

Macoma (Cymatoica) vendryesi Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1056, plate 46, fig. 3.

The following is the original description of this species:

Shell minute, thin, flexuous, rostrate, inequivalve, inequilateral, gaping behind, moderately inflated, anterior end full, rounded, shorter; posterior end longer, rectilinear above, sinuous below, produced into an obliquely truncated rostrum; beaks low, pustular; left valve slightly less convex than the right and a little longer; surface concentrically irregular undulated except on the posterior dorsal area, which is transversely striated; pallial sinus small, short, partly confluent below with the pallial line. Lon. 7, alt. 4, diam. 2 mm.

Type locality.—Bowden, Jamaica.

M. (C.) hispaniolae Maury, from the Cercado formation of the Dominican Republic is very similar, but is slightly larger and more elongate.

Type material.—2 cotypes (left valves, U.S.Nat.Mus.No.135695).

Family SEMELIDAE.

Genus SEMELE Schumacher.

Section SEMELE s. s.

Schumacher, 1817, Essai d'un Nouveau Système des Habitations des Vers Testacés, p. 165.

Type (by monotypy).—Tellina reticulata Spengler. (=*Tellina proficua* Pulteney). Recent, southeastern United States and the West Indies.

The following is a description of the section *Semele* s. s.:

Shell medium-sized, elliptical-orbicular, sculpture consisting of concentric lamellae frilled by fine radials; ligament very narrow, resilium seated on a wide, deeply inset chondrophore; hinge of right valve consisting of 2 slender cardinals (3*a*, 3*b*), the posterior one (3*b*) larger, and strong anterior and posterior laterals; hinge of left valve consisting of 2 slender cardinals (2*a*, 2*b*), the anterior one (2*a*) larger, and heavy anterior and posterior laterals; pallial sinus ascending, reaching middle of shell, its apex broadly U-shaped, entirely free of pallial line.

The living species of *Semele,* like the Tertiary species, are widely distributed in the tropical and subtropical seas.

Semele (Semele) calliconcinnata, new species.

(Plate 25, Figures 1, 2.)

The following is a description of this species:

Shell small, subelliptical, moderately inequilateral, moderately inflated; sculpture reticulate, consisting of equally spaced concentric lamellae, their

edges thickened and frilled at the points of intersection with narrow radial threads, which are separated by slightly wider interspaces and are more closely spaced on median part of shell; near the ends conspicuous beads lie at the intersections; between the concentric lamellae are fine concentric threads; left laterals weak; pallial sinus deep, its apex broadly U-shaped.

Length 9 mm.; height 6.5 mm.; diameter (left valve) 1.8 mm.

This species closely resembles young specimens of the Pliocene and living species *S. bellastriata* (Conrad), but is more inflated, and has more broadly rounded ends and fewer and wider radial threads.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352853).

Genus ABRA Lamarck.

Section ABRA s. s.

Leach (manuscript name in) Lamarck, 1818, Histoire Naturelle des Animaux sans Vertèbres, vol. 5, p. 492.

Type (by monotypy).—Mactra tenuis Montagu. Recent, seas of Europe.

The following is a description of the section *Abra* s. s.:

Shell small, trigonal; sculpture consisting of incrementals; ligament narrow, resilium seated on a wide, deeply inset chondrophore; hinge of right valve consisting of 2 cardinals (3*a*, 3*b*), the posterior one (3*b*) heavier, and slender anterior and posterior laterals; hinge of left valve consisting of 2 cardinals (2*a*, 2*b*), the posterior one (2*b*) very small; pallial sinus deep, very wide, confluent with pallial line.

Abra is represented in both temperate and tropical Tertiary and living faunas of Europe and America.

Key to the Bowden species of Abra s. s.

Sculpture consisting of incrementals..... *A.* (*A.*) *triangulata*
Sculpture consisting of thin concentric threads..... *A.* (*A.*) *deutera*

Abra (Abra) triangulata Dall.

(Plate 25, Figures 3, 4.)

Abra triangulata Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 997, plate 49, fig. 4. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 431, plate 32, fig. 10.

The following is the original description of this species:

Shell small, thin, polished, subtrigonal, nearly equilateral, wider than high, moderately inflated; beaks pointed, not much elevated, the dorsal margins straight, diverging at the umbo in an angle of somewhat over 90°; base arcuate; anterior end slightly longer, rounded; posterior end shorter, more pointed; exterior polished; anterior dorsal margin in the right valve with a lateral tooth at some distance from the hinge-plate; on the posterior margin is a short fold not elevated to become a tooth; the left valve shows no laterals. Alt. 5.5, lat. 5.25, diam. 3.0 mm.

Type locality.—Bowden, Jamaica.

The right laterals are far from the cardinals. Specimens from the Gatun formation of Bocas Island, described by Olsson, are larger and more elongate than the holotype, but resemble some Bowden specimens.

Other localities.—Gatun formation (middle Miocene), Panama.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135700).

Abra (Abra) deutera, new species.

(Plate 25, Figures 5, 6.)

The following is a description of this species:

Shell small, thin, subtrigonal, subequilateral, anterior end slightly more extended; umbo full, low, subcentral; sculpture consisting of fine, thin, regularly spaced concentric threads, on some parts of the shell forming thin lamellae, and fine more obscure, widely spaced radial markings; chondrophore narrow; right cardinals heavy, laterals distant from cardinals; pallial sinus obscure.

Length 4 mm.; height 3.5 mm.; diameter (right valve) 1.6 mm.

A. deutera is represented by 2 right valves. It is distinguished from young shells of *A. triangulata* by its less acute umbo, greater inflation, and distinct sculpture. On translucent shells the radials are very obscure.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352855).

Family DONACIDAE.

Genus DONAX Linné.

Section DONAX s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 682.

Type (by subsequent designation, Gray, 1847).—Donax rugosa Linné. Recent, West Indies.

The following is a description of the section *Donax* s. s.:

Shell medium-sized, inequilateral, elongate wedge-shaped, posterior end having a greater diameter than anterior; sculpture consisting of slightly nodular radial threads on posterior end, and obscure radial threads on middle of shell; ligament narrow, deeply inset; resilium seated on a short, wide, excavated nymph, the posterior end of which is a sharp-pointed projection bent backward toward ligament; hinge of right valve consisting of a small anterior cardinal (3*a*), a heavy, bifid and roughened posterior cardinal (3*b*), and conspicuous double anterior and posterior laterals; hinge of left valve consisting of an elongate roughened anterior cardinal (2), a small posterior cardinal (4), and a conspicuous posterior lateral; pallial sinus deep, its apex broadly U-shaped, partly confluent with pallial line; anterior adductor scar higher, longer and more deeply inset than posterior; inner margin of valve coarsely fluted.

Donax trunculus Linné, the only species given by Lamarck in the Prodrome, usually is given as the type species. Species of the group

of *D. rugosa* usually are placed in the subgenus *Chion* Scopoli. They are characterized by strong laterals.

Donax s. s. is represented by living species in the tropical seas of the West Indies, west Africa and the Pacific. The earliest species are recorded from European Eocene deposits.

Donax (Donax) species.

(Plate 25, Figures 7, 8.)

A broken right valve in the U. S. National Museum collection seems to represent a *Donax* s. s., as it has strong anterior and posterior laterals. The shell is elongate, inequilateral, and has obscure radial sculpture; the chondrophore is very small. The anterior lateral is longer than in *D. rugosa* and closer to the cardinals.

This species resembles *D. chipolana* Dall, from the Chipola formation of Florida.

Section PARADONAX Cossmann.

Cossmann, in Cossmann and Peyrot, 1910, Conchologie Néogenique de l'Aquitaine, vol. 1, p. 293.

Type (by original designation).—Donax transversa Deshayes. Miocene, France.

The following is a description of the section *Paradonax:*

Shell small, inequilateral, elongate wedge-shaped; surface smooth, but obscure radials are visible under the polished surface; anterior part of ligament on left valve limited on side toward hinge by a rib that extends down on hinge-plate; chondrophore much smaller and less deeply excavated than in *Donax* s. s.; hinge of right valve consisting of a very slender anterior cardinal (3*a*), a heavier posterior cardinal (3*b*), and 2 prominent posterior lateral lamellae; hinge of left valve consisting of an anterior (2) and posterior (4) cardinal, almost equal in size, and a prominent posterior lateral; pallial sinus resembling *Donax* s. s.; inner margin of valve conspicuously fluted.

The double right posterior lateral and the absence of anterior laterals are the most characteristic features of *Paradonax.* The Bowden species, *D. lennoxi,* is more equilateral and more trigonal than the type species; its nymph is so small that it is obscure; its left posterior lateral is closer to the cardinals than in the type species. No right valves of this species have been found, but right valves of *D. aequalis* Gabb, a similar Miocene species from the Dominican Republic, have the same hinge as the type species. The rib along the anterior part of the ligament on left valves of *D. transversa* extends down on the hinge plate as a false tooth.

Paradonax has been represented in European waters since Eocene time. *D. lennoxi* and *D. aequalis* are the only American species so far known.

Donax (Paradonax) lennoxi, new species.

(Plate 25, Figures 9, 10.)

Donax aequalis Dall, 1900 (part, not Gabb), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 966.

The following is a description of this species:

Shell small, thin, trigonal, subequilateral; posterior end more inflated and less extended than anterior; sculpture consisting of narrow radial threads on posterior end, and of obscure radial markings, not standing in relief except on worn areas, on the rest of the shell; chondrophore very small; rib along anterior part of ligament extending down on hinge plate of left valve; hinge of left valve consisting of a long, slender anterior cardinal (2), a smaller and heavier posterior cardinal (4), and a posterior lateral; pallial sinus obscure; inner ventral margin finely fluted.

Length 4.5 mm.; height 3.2 mm.; diameter (left valve) 1.1 mm.

This species resembles *D. aequalis* Gabb, from the Cercado formation of the Dominican Republic, but is smaller, more inequilateral, and has less distinct sculpture.

Type material.—Holotype (left valve, 1 of 3 specimens in the Henderson collection labeled *Donax aequalis* Gabb, U. S. Nat. Mus. No. 135693).

Superfamily SOLENACEA.

Family SOLENIDAE.

Genus PSAMOSOLEN Risso.

Risso, 1826, Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes Maritimes, vol. 5, p. 397, (index). Correction for *Psammobia* on p. 375, vol. 4.

Type (by subsequent designation, Dall 1900).—Solen strigilatus Linné. Recent, Mediterranean Sea.

The following is a description of the genus *Psamosolen:*

Shell large, subrectangular, both ends rounded, moderately inequilateral, gaping at both ends; sculpture consisting of distant oblique rugae that disappear on anterior end; nymph long, thick; hinge of right valve consisting of a long conical anterior tooth (3*a*) bent upward, and a compressed oblique posterior tooth (3*b*); hinge of left valve consisting of a short anterior tooth (2), joined to a slender tooth extending along the nymph (4*b*); pallial sinus deep, U-shaped, the lower limb almost confluent with pallial line.

Living species of *Psamosolen,* also known as *Solenocurtus,* are widely distributed in the warmer seas. The Tertiary species had a similar extensive distribution.

Psamosolen sancti-dominici Maury.

(Plate 25, Figures 11 to 14.)

Psamosolen vicksburgensis Dall, 1900 (part, not Aldrich), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 960.

Psamosolen sancti-dominici Maury, 1917, Bull. Amer. Paleontology, vol. 5, pp. 392–393, plate 63, fig. 13.

The following is the original description of this species:

Shell, thin, delicate, with a broad shallow sulcus passing from the umbo to the ventral margin; dorsal and ventral margins subrectilinear, almost parallel; surface marked by occasional, concentric growth lines, and very elegantly chiseled with close-set, slightly wavy, parallel, incised lines which run in an oblique direction over the posterior and central part of the valve, but at the anterior [posterior] end their distal ends turn forwards and upwards in graceful curves; very near the anterior dorsal margin the incised lines are obsolete. . . . . Pallial sinus tongue-shaped, very deep, extending forward into the anterior third of the valve. Length of shell 27, altitude 12, semi-diameter 4 mm.

Type locality.—Bluff 3, Rio Mao, Dominican Republic.

The largest Bowden specimen has the following dimensions: length 48 mm.; height 19.5 mm.; diameter (left valve) 6.5 mm. The type is much smaller, but broken valves from the Cercado formation are a little larger than the largest Bowden valves.

The shell is very inequilateral. The oblique rugae are absent on the anterior end, and on large shells disappear on the extreme posterior part. They are more closely spaced on some shells than on others.

This species is larger than *P. vicksburgensis* (Aldrich), from the Byram marl of Mississippi, more elongate, more inflated, and has less abruptly rounded ends. It closely resembles the Pliocene and living *P. cumingianus* (Dunker), but is a little less inequilateral and the central part of the shell is more depressed.

Small specimens from the Gurabo formation of the Dominican Republic seem to represent this species.

Other localities.—Cercado formation (lower Miocene), and Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Cornell University.

Superfamily MACTRACEA.

Family MACTRIDAE.

Genus SPISULA Gray.

Subgenus SPISULA s. s.

Section SPISULA s. s.

Gray, 1838, Annals and Magazine of Natural History, new ser., vol. 1, p. 372.

Type (by subsequent designation, Gray, 1847).—Mactra solida Linné. Recent, seas of Europe.

The following is a description of the subgenus *Spisula* s. s.:

Shell medium-sized, trigonal-ovate, subequilateral, posterior end having an obscure ridge; ligament small, seated on narrow area along dorsal margin, which is not separated from the chondrophore by a ridge; chondrophore large, triangular; hinge of right valve consisting of an anterior cardinal divided into a long anterior part (3*a*) and a short posterior part (3*b*), which is continuous with the thin plate along the side of the chondro-

phore, and 2 anterior and posterior laterals, their inner faces bearing file-like ridges; hinge of left valve consisting of an anterior cardinal divided to form an inverted V (2*a*, 2*b*), and an anterior and posterior lateral, their upper and lower surfaces ridged; pallial sinus short, U-shaped.

The absence of a ridge between the ligament area and chondrophore is the most characteristic feature of the genus *Spisula*.

Section MACTROMERIS Conrad.

Conrad, 1868, American Journal of Conchology, vol. 3, part 3, appendix p. 45.

Type (*by subsequent designation, Dall, 1898*).—*Spisula ovalis* (Gould) (=*Mactra polynyma* Stimpson). East coast of the United States.

The following is a description of the section *Mactromeris:*

Shell large, trigonal; hinge resembling *Spisula* s. s., but the laterals are not ridged; sinus resembling *Spisula* s. s.

Mactromeris is an American group of Mactroids, first appearing in the Oak Grove sand (lower Miocene) of Florida.

Spinula (Mactromeris) matleyi, new species.

(Plate 25, Figures 15, 16.)

The following is a description of this species:

Shell small, elongate-trigonal, subequilateral, posterior end obscurely ridged; sculpture consisting of incrementals; ligament area separated from the large chondrophore by a very low ridge; hinge of right valve consisting of an anterior cardinal divided into a long anterior part (3*a*) and a shorter posterior part (3*b*) continuous with the thin ridge along the anterior side of the chondrophore; upper margin of shell thickened along posterior part of cardinal; anterior and posterior laterals short.

Length 25 mm.; height 16.5 mm.; diameter (right valve) 4 mm.

This species is represented by an imperfect right valve, but all the features of the shell, except the pallial sinus, are visible. The anterior part (3*a*) of the cardinal is broken, but apparently it is not continuous with the lower anterior lateral, although the anterior laterals are closer to the cardinal than in the type species. The shell is much smaller and more elongate than the type species, resembling the genus *Mulinia*.

S. (*M.*) *matleyi* resembles *S.* (*M.*) *duplinensis* Dall, from the Duplin marl of North Carolina, but is much smaller; its ligament area is more excavated; and the thickened margin of the shell is more distinctly joined to the posterior part (3*b*) of the right cardinal.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 352857).

Family MESODESMATIDAE.

Genus ERVILIA Turton.

Turton, 1822, Conchylia Insularum Brittannicarum, p. 55.

Type (*by monotypy*).—*Mya nitens* Montagu. Recent, West Indies.

The following is a description of the genus *Ervilia:*

Shell small, elongate-ovate, moderately inequilateral; sculpture consisting of closely spaced concentric rugae; chondrophore triangular, placed under umbo; hinge of right valve consisting of a heavy bifid anterior cardinal (3) and a rudimentary posterior tooth probably representing a lateral; hinge of left valve consisting of an obscure oblique, inverted V-shaped anterior cardinal, the posterior part (2*b*) coinciding with edge of chondrophore, the anterior part (2*a*) smaller and scarcely diverging from margin of shell; left valve having an anterior and posterior thickening of the hinge margin close to the chondrophore; pallial sinus short, broadly U-shaped; interior of shell thickened between umbo and anterior adductor scar.

In Europe, *Ervilia* first appears in the Aquitanian of Aquitaine. The earliest American species comes from the Chipola formation (lower Miocene) of Florida and deposits of the same age in the West Indies. The living species inhabit the warm temperate and tropical seas.

Ervilia gabbi, new species.

(Plate 25, Figures 17, 18.)

The following is a description of this species:

Shell small, thin, ovate-trigonal, subequilateral, strongly inflated; posterior end slightly more extended and more abruptly rounded; dorsal margins subequal in length and sloping at same angle; base gently and symmetrically arcuate; umbos full, subcentral; sculpture consisting of fine regular concentric rugae, obscure radial markings are visible on the posterior end; anterior and posterior dorsal margins of right valve having long grooves.

Length 5 mm.; height 3.2 mm.; diameter (left valve) 1.5 mm.

This species is virtually equilateral, strongly inflated, and has relatively conspicuous concentric sculpture. Both species from the Chipola formation, *E. chipolana* Dall and *E. triangularis* Dall, are more inequilateral, and have a more extended posterior end and less conspicuous sculpture. *E. gabbi* more closely resembles the Duplin marl species *E. lata* Dall and the living *E. concentrica* Gould, both of which are slightly more inequilateral and more compressed. The Pliocene species *E. polita* Dall is slightly larger, more inequilateral, and more compressed, and has weaker sculpture.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 352858).

Superfamily MYACEA.

Family CORBULIDAE.

Genus CORBULA Lamarck.

Section CORBULA s. s.

Lamarck, 1801, Systême des Animaux sans Vertèbres, p. 137.

Type (*by subsequent designation, Gray, 1847*).—*Corbula sulcata* Lamarck. Recent, west coast of Africa.[1]

[1] I have not seen the type species. The description is taken from Cossmann and Peyrot, 1909.

The following is a description of the section *Corbula* s. s.:

Shell small, trigonal-ovate, inequilateral, inequivalve, the right valve larger, posterior end rostrate; sculpture consisting of concentric waves, similar on both valves of the type species; chondrophore deeply inset; hinge of right valve consisting of a strong anterior cardinal and an obscure posterior lateral; left valve bearing a deep socket in front of the chondrophore, and an obscure lateral lamella behind the chondrophore; pallial sinus very shallow.

Aside from the peculiar *Bothrocorbula,* two kinds of Corbulas are represented in the Bowden formation. Neither is exactly similar to *Corbula sulcata. C. sericea* is moderately inequivalve and the valves have similar sculpture. *C. heterogena* is very inequivalve and the valves have dissimilar sculpture. American Tertiary species similar to *C. sericea* are commonly placed in the section *Cuneocorbula* Cossmann, but the type of that section—*C. biangulata* Deshayes, an Eocene species from the Paris Basin—is bicarinate. American Tertiary species similar to *C. heterogena* usually are placed in the section *Aloidis* Megerle von Mühlfeldt, which has the same type as *Corbula* s. s. Some European palaeontologists use the name *Agina* Turton for Corbulas similar to *C. heterogena. "Mya purpurea* Montagu" is the only species listed by Turton under *Agina.* According to Turton's figure, this species is a *Saxicava.* As no name seems to be available for Corbulas having dissimilarly sculptured valves, both Bowden species are placed in the section *Corbula* s. s.

Key to the Bowden species of Corbula s. s.

Shell moderately inequivalve, sculpture similar on the two valves.... *C.* (*C.*) *sericea*
Shell very inequivalve, sculpture dissimilar on the two valves.... *C.* (*C.*) *heterogena*

Corbula (Corbula) sericea Dall.

(Plate 25, Figures 19 to 22.)

Corbula cubaniana Guppy, 1874 (part, not d'Orbigny), Geol. Mag, decade 2, vol. 1, p. 441 (list).

Corbula (*Cuneocorbula*) *sericea* Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 848; 1900, vol. 3, part 5, plate 36, fig. 8.

?*Corbula sericea* Dall, Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 371. Not Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 427 (=*C. cercadica* Maury).

The following is the original description of this species:

Shell much like the preceding species [*C. seminella* Dall] in general form, but slightly larger and with less emargination beneath the rostrum. The sculpture, however, is quite different, being of very numerous, equal, fine, sharp, close-set ribs, the interspaces crossed by fine, close, sharp radial striation, which at once distinguishes it from any of the allied species. Both valves are similarly sculptured, the sculpture becoming obsolete on the beaks. Lon. 4.5, alt. 3.5, diam. 2.3 mm. The largest valve measures 5.4 by 4 mm.

Type locality.—Limon, Costa Rica.

The right valve of this species is slightly larger than the left. Guppy listed *"C. cubaniana"* only from Pliocene beds at Matura, Trinidad, but specimens of *C. sericea* from Bowden in the Guppy collection are labeled *"C. cubaniana."*

The type of *C. sericea* is from Limon, Costa Rica. Its age is not known, as both Miocene and Pliocene beds crop out near Limon. The specimens from Bowden are smaller and heavier, and many have obscure radial sculpture, but they resemble small specimens from Limon.

C. sericea is very abundant at Bowden. It is smaller and not so elongate as *C. cercadica* Maury, from the Cercado and Gurabo formations of the Dominican Republic. The Pliocene (?) species from Costa Rica described by Gabb as *C. lavaleana* d'Orbigny is even more elongate. The Miocene species from Costa Rica described by Gabb under the same name may be *C. sericea.* The valve from the Gatun formation of the Canal Zone, called *C. sericea* by Brown and Pilsbry, is larger, and has a wider posterior slope and straighter posterior margin.

Other localities.—Middle Miocene (?), Costa Rica. ? Gatun formation (middle Miocene), Panama Canal Zone.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135655).

Corbula (Corbula) heterogena Dall.

(Plate 26, Figures 1 to 4.)

Corbula vieta Guppy, 1866 (part), Quart. Jour. Geol. Soc. London, vol. 22, pp. 580–581 (not plate 26, fig. 8), right valve. Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 85 (name only). Guppy, 1874 (part), Geol. Mag., decade 2, vol. 1, p. 441 (list).

Corbula disparilis Guppy and Dall, (not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19. p. 327.

Corbula (Aloidis) heterogena Guppy Mss., Dall, 1898 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 850, plate 46, fig. 15.

Corbula heterogena Guppy, Brown and Pilsbry, Proc. Acad. Nat. Sci. Philadeplhia, vol. 63, p. 372.

The following is the original description of this species:

This form is very close to *C. vieta,* but differs from it in having the beaks narrower, less elevated, and less prominent, and the posterior part of the shell more produced. Lon. 9.5, alt. 8, diam. 5 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Right valve medium-sized, high, trigonal, greatly inflated, moderately inequilateral, posterior end slightly more extended; dorsal margins subequal in length, concave; anterior end rounded, posterior end truncate; umbos full, high, strongly incurved and moderately or strongly prosogyrate, subcentral; near the posterior margin lies an obscure ridge, in front of it lies a stronger broadly rounded ridge; area between ridges flattened or slightly

depressed; sculpture consisting of strong concentric rugae of medium width; *left valve* small, elongate ovate, moderately inflated, moderately inequilateral; anterior end rounded, posterior end truncate; anterior dorsal margin slightly concave, posterior dorsal margin slightly longer and straight; umbos full, moderately high, placed in front of middle; posterior ridge low, obscure; sculpture consisting of obscure, fine concentric rugae, suppressed over much or all of surface, and about 10 to 12 very narrow radial threads, the posterior slope having no radial sculpture; chondrophore almost horizontal, its lower and posterior margins greatly thickened.

A right valve: length 8 mm.; height 7mm.; diameter 3 mm.

A left valve: length 5.5 mm.; height 4 mm.; diameter 2 mm.

Right valves of this species are very abundant, but left valves are less abundant. Some right valves have a more extended posterior end than others.

The type material of *C. vieta* Guppy (U. S. Nat. Mus. No. 115650) comes from beds of Miocene age at Manzanilla, Trinidad.[1] These valves (right valves) are larger than right valves of *C. heterogena,* and have wider, higher umbos, less extended posterior area, and slightly coarser sculpture. Left valves of *C. vieta* from Manzanilla, described by Guppy as *Erycina tensa,* are larger, less inflated and more smoothly ovate than left valves of *C. heterogena.* Olsson thought *Erycina tensa* could not be the left valve of a *Corbula,* but an examination of Guppy's types removes any doubt.

Spieker[2] has compared several similar Corbulas of this group. Right valves of *C. bradleyi* Nelson, from the Zorritos formation of Peru, are less triangular than right valves of *C. heterogena* and have coarser sculpture. Right valves of the species from the Cercado formation of the Dominican Republic described by Maury as *"C. vieta"* are less elongate and more inflated than right valves of *C. heterogena;* left valves have the same shape, but the umbo of the Dominican species is lower and the margin of the chondrophore is not so thick. Left valves of a species from the Gurabo formation of the Dominican Republic are more orbicular and have higher umbos than left valves of *C. heterogena.* Right valves of *"C. vieta"* Olsson, from Miocene beds in Costa Rica and Panama, also are less elongate than *C. heterogena.*

C. heterogena seems to be confined to the Bowden and Gatun formations. There are many similar species in the Miocene and Pliocene deposits of southeastern United States, such as *C. chipolana* Dall (MS.) Gardner from the Chipola formation, *C. waltonensis* Gardner (MS.) from the Oak Grove sand, and *C. caloosae* Dall from the

[1] Specimens from Matura, Trinidad (U. S. Nat. Mus. No. 115651) also are labeled "types," but Guppy figured a specimen from Manzanilla. The specimens from Matura are more trigonla than those from Manzanilla.

[2] E. M. Speiker. Johns Hopkins University Studies in Geology, No. 3, pp. 170–172, 1922. Spieker erroneously states that I consolidated *C. vieta* and *C. heterogena.* The citations of *C. vieta* in the synonomy refer to Guppy's consolidation of Bowden and Trinidad specimens under the same name.

Caloosahatchee marl of Florida. *C. disparilis* d'Orbigny is the living West Indian representative of this group.

Other localities.—Gatun formation (middle Miocene), Panama Canal Zone.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 107099).

Section BOTHROCORBULA Gabb.

Gabb, 1872, Proceedings Academy of Natural Sciences of Philadelphia for 1872, p. 274.

Type (by monotypy).—Corbula viminea Guppy. Miocene, Jamaica.

The following is a description of the section *Bothrocorbula:*

Shell moderately large, thick, elongate-ovate, moderately inequilateral, posterior end ridged, right valve slightly larger than left; sculpture of both valves consisting of coarse concentric waves; in front of the umbones lies a deep lunular depression; hinge resembling *Corbula* s. s.

The deep lunular depression is a characteristic feature of *Bothrocorbula.* This section is an American group and is particularly characteristic of the Miocene deposits of the West Indies and Central America, but occurs in the subtropical faunas of the mainland. A species from the Chipola formation of Florida, *C. synarmostes* Dall, has a shallow pit; *C. radiatula* Dall, from the Oak Grove sand of Florida, has a larger and deeper pit; and *C. willcoxi* Dall, from the Caloosahatchee marl of Florida, has as large and as deep a pit as the type species. According to Dall, Stimpson reported having dredged a living *Bothrocorbula* in the deep water of Florida Strait. The specimens were lost in the Chicago fire. Aside from this doubtful record, *Bothrocorbula* is extinct.

Corbula (Bothrocorbula) viminea Guppy.

(Plate 26, Figures 5 to 8.)

Corbula viminea Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 293, plate 18, fig. 11. Guppy, Geol. Mag., 1874, decade 2, vol. 1, p. 441 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 529. Not Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 372 (=*C. hexacyma* Brown and Pilsbry).

Bothrocorbula viminea (Guppy), Gabb, 1872, Proc. Acad. Nat. Sci. Philadelphia, p. 274, plate 10, figs. 3, 3*a*. Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 247.

Corbula (*Bothrocorbula*) *viminea* Guppy, Dall, 1898 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 850. Maury, 1917, Bull. Amer. Paleontology, vol. 5, pp. 397–398, plate 65, figs. 20, 21. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 428. Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 442, plate 31, fig. 25.

The following is the original description of this species:

Shell thick, transversely oblong, rounded anteriorly, produced posteriorly into an acute beak; valves ornamented with stout, rather round, concentric

ribs; hinge with a single prominent tooth and a deep orbicular pit in front of it.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell large, thick, moderately inflated, elongate, inequilateral; posterior end ridged, base emarginate in front of ridge; lunular depression deep, subspherical, larger on left valve; sculpture consisting of coarse concentric waves, which are suppressed before the posterior ridge is reached, fine concentric striae are engraved on the waves and are continuous across the posterior slope and the area in front of it; radial sculpture consisting of fine, obscure, distant radial threads between the waves, absent on the posterior slope.

Length 17.5 mm.; height 12 mm.; diameter (right valve) 4.8.

This species has a remarkably deep lunular pit. On some specimens the faint radial sculpture is absent. Most of the specimens from the Cercado formation of the Dominican Republic are smaller and a little more elongate than specimens from Bowden. A more elongate undescribed species occurs in the Thomonde formation (lower Miocene) of the Republic of Haiti. No *Bothrocorbula* has been collected from the Gurabo formation. A specimen from the Gatun formation of the Canal Zone in the collection of the U. S. National Museum labeled *C. viminea* is *C. hexacyma* Brown and Pilsbry, a species remarkably similar to *C. viminea,* but having no lunular pit. Olsson has reported *C. viminea* from the Gatun formation of Costa Rica.

Other localities.—Cercado formation (lower Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype, British Museum (Natural History), Geological Department, No. 64088.

Superfamily PANOPEACEA.
Family BASTEROTIDAE.
Genus BASTEROTIA Mayer.
Section BASTEROTIA s. s.

Mayer, in Hörnes, 1870, Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt, vol. 4, p. 40.

Type (by monotypy).—Basterotia corbuloides Mayer. Miocene, Vienna basin.[1]

The following is a description of the section *Basterotia* s. s.:

Shell medium-sized, subquadrate, strongly inflated, posterior end strongly ridged; umbos high, wide, posterior ridge extending to tip of umbo; sculpture consisting of fine granules and incrementals; ligament external, seated on a tooth-like nymph above and behind the tooth; hinge of right valve consisting of a prominent subumbonal tooth, separated from nymph by a narrow gap; hinge of left valve consisting of a similar tooth, separated from nymph by socket into which tooth of right valve fits; pallial line simple.

[1] I have not seen the type species. The description is taken from Cossmann and Peyrot. 1909.

Basterotia s. s. is represented by Miocene species in Europe. The Bowden species, *B. bowdeniana,* is the only American Tertiary species. The living species seem to be confined to the West Indies and Pacific Ocean.

Basterotia (Basterotia) bowdeniana (Dall).

(Plate 26, Figures 9, 10.)

Anisodonta (Basterotia) bowdeniana Dall, 1900, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 5, p. 1133.

The following is the original description of this species:

A species of *Basterotia,* which appears to be clearly distinct from *B. quadrata* Hinds, is represented by a broken right valve in the collection made by Henderson and Simpson at Bowden. Hardly complete enough to figure, it may be described as distinguished from *B. quadrata* by the following characters. The keel, which is so prominent a feature in *B. quadrata,* in the present shell is well marked only on the beak, rapidly becoming obsolete distally and represented only by a rounded ridge, which passes imperceptibly into the general convexity of the valve. The beaks in *B. bowdeniana* are less angular and elevated, the shell thinner and more ovate, the hinge-line longer, the elevated tooth smaller in proportion to the shell and much more delicate. The sculpture is minutely sagrinate, the length 10.5, the diameter about 5 millimeters.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell medium-sized, subovate, posterior end not ridged, except near umbo, where the ridge is broad and rounded; umbo low; sculpture consisting of very minute granules, absent on posterior third of shell; nymph eroded, short, slender, limited above by a narrow groove, separated from the tooth by a narrow gap; tooth of right valve long, slender; left valve not known.

In outline this species is entirely different from the type species and the similar West Indian species *B. granatina* Dall, and Pacific species *B. quadrata* (Hinds). *B. bowdeniana* closely resembles the living West Indian species known as *B. elliptica* (Recluz), but has a shorter nymph. The Bowden species apparently resembles *B. biali* Cossmann and Peyrot, from the upper Burdigalian of Bordelais. The outline of the Bowden species recalls *Fulcrella,* but the nymph is shorter, and the tooth more slender and longer.

Type material.—Holotype (right valve, U. S. Nat. Mus. No. 135749).

Superfamily EDENTULACEA.

Family GASTROCHAENIDAE.

Genus GASTROCHAENA Spengler.

Subgenus GASTROCHAENA s. s.

Spengler, 1783, Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter, vol. 2, p. 179.

Type (by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1896).—Gastrochaena cuneiformis Spengler (? =*Mya hians* Gmelin). Recent, West Indies.

The following is a description of the subgenus *Gastrochaena* s. s.:

Shell medium-sized, twisted, elongate wedge-shaped, equivalve, umbos near anterior end; gape very wide and long; sculpture consisting of incrementals; ligament seated on a slender nymph; hinge having no teeth; under the umbo lies a rude myophore; pallial sinus moderately deep, U-shaped; shell embedded in burrows lined with calcareous material, or protected by a calcareous tube.

In America, species of *Gastrochaena* probably first appear in lower Miocene deposits, although some Eocene species are referred to this genus. The living species are widely distributed.

Gastrochaena (Gastrochaena) rotunda Dall.

(Plate 26, Figures 11, 12.)

Gastrochaena ovata Sowerby var. *rotunda* Dall, 1898 (part), Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, p. 825.

Gastrochaena rotunda Dall, Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 438. Not Dall, 1915, Bull. U. S. Nat. Mus. No. 90, p. 157. (Plate 19, fig. 2, represents a specimen from the Chipola formation).

The following is the original description of this species:

Shell resembling the *ovata* of the same size, but not attaining so large a size as the adult *ovata*, with a more rounded posterior end, rather shorter gape, the myophore decidedly larger, wider, and more conspicuous. Lon. 7, lat. 3.5, diam. 2.8 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell medium-sized, thin, elongate, wedge-shaped, umbos near anterior end; gape very wide and long; sculpture consisting of incrementals, which are elevated into rude lamellae on anterior part of shell; nymph long and slender; under the umbo lies a short oblique myophore; pallial sinus obscure.

Length 19 mm.; height 7.5 mm.; diameter (left valve) 3.5 mm.

The left valve figured is much larger than the cotypes and is correspondingly larger than any specimens from the Chipola formation. It also has a much heavier and more oblique myophore than specimens from the Chipola formation, which probably represent a different species. The Bowden species resembles the living *G. ovata* Sowerby, but is smaller, thinner, more elongate and has a more distinct myophore.

A small similar *Gastrochaena* has been collected from the Gurabo formation. Olsson records *G. ovata* from the Gatun formation of Costa Rica. The shell figured by Dall in the report on the Tampa mollusks is from the Chipola formation. Indeterminable burrows are the only specimens from the Tampa formation.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—2 cotypes (U. S. Nat. Mus. No. 135742).

Superfamily ADESMACEA.

Family PHOLADIDAE.

Genus JOUANNETIA Des Moulins.

Des Moulins, 1828, Bulletin d'Histoire Naturelle de la Société Linnéenne de Bordeaux, vol. 2, (p. 246 of reprint, 1845).

Type (by monotypy).—Jouannetia semicaudata Des Moulins. Miocene, France.[1]

The following is a description of the genus *Jouannetia:*

Shell thin, strongly inflated, gape closed by a callus extending from left valve to right; right valve having a posterior rostiform appendage; umbos central; valves having an oblique groove extending down from umbos; sculpture consisting of lamellar incrementals, which are stronger in front of groove; myophore short, slender; pallial sinus deep.

The following species seem to be a *Jouannetia.* At the present time the genus is confined to the Indo-Pacific region. Eocene, Oligocene, and Miocene species are recorded from Europe.

Jouannetia sphaeroidalis (Guppy) (MS. name).

(Plate 26, Figures 13 to 15.)

Martesia sphaeroidalis Guppy, name on label.
Teredina ? doubtful species, Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, pp. 327–328.

The following is the description of this species given by Guppy and Dall:

Almost globular, anterior end finely closely laminose, posterior area subequal, nearly smooth, the medial groove feebly marked; callum apparently complete, siphonal end slightly gaping, truncate, the margins thickened and reflected, the dorsal plates wanting, probably lost. Alt. 6 mm.

Type locality.—Jamaica.

The following is a description of this species:

Shell small, thin, spherical, equivalve, posterior end gaping; posterior margin of valve thickened, especially near umbo; umbo low, partly covered by callus extending over anterior part of shell, closing anterior gape; shell having an oblique groove extending from umbo to ventral margin; area between groove and anterior callus sculptured with oblique lamellar incrementals; at the groove the incrementals are angulated, behind the groove they are non-lamellar; interior inaccessable.

Length 6.5 mm.; height 6.7 mm.; diameter (both valves) 6 mm.

This species is represented by 2 specimens having both valves attached. If it is a *Jouannetia* both specimens are not full grown, as there is no trace of a posterior appendage on the right valve. The shells are equivalve, a feature that supports the supposition that they are not full grown. No American species of *Jouannetia* have heretofore been described.

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[1] I have not seen the type species. The description is taken from Cossmann and Peyrot, 1909.

Type material.—Holotype (right and left valves of the same shell, originally in attached position, U. S. Nat. Mus. No. 107100).

Genus MARTESIA Leach.

Leach, in Blainville, 1824, Manuel de Malacologie et de Conchyliogie, p. 632.

Type (by subsequent designation, Gray, 1847).—Pholas clavata Lamarck (=*Pholas striata* Linné). Recent, seas of Europe.

The following is a description of the genus *Martesia:*

Shell thin, medium-sized, elongate, wedge-shaped, inequilateral, gaping at posterior end; a shallow groove extends from the umbo to the ventral margin; lower anterior part of shell covered with callus closing the anterior gape, the edge of the callus extending along the upper anterior margin; part of shell in front of groove sculptured with roughened threads; back of the groove these threads are replaced by crude incrementals; umbo covered with accessory plates; ventral margins connected by an accessory plate for greater part of distance behind groove; myophore long, slender, curved.

According to Cossmann, Mesozoic and even Carboniferous mollusks have been referred to *Martesia,* but the pre-Eocene species are doubtful. The living species have an extensive distribution.

Martesia bowdeniana (Dall).

(Plate 26, Figures 16, 17.)

Teredina bowdeniana Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. 3, part 4, pp. 822–823, plate 36, fig. 4.

The following is the original description of this species:

The specimen obtained is the portion of a tube containing most of the left valve of a *Teredina,* with very marked sculpture. The anterior border is formed by a narrow, irregularly broken strip of the shelly matter belonging to the missing tube. The thin posterior border of the valve is not intact, though enough remains to show the character of the sculpture. The sculpture of the anterior part of the valve is composed of small, four-sided lozenges, separated by sharp, narrow, arcuate grooves in such a way as to produce the effect of a parting on the periphery of the valve. This grooved and faceted sculpture ceases abruptly behind, but the rows of facets are continued as wider longitudinal riblets posteriorly. The umbonal reflection is heavy and radially striate; the apophysis seems to have been obsolete and its remains appressed to the internal arch of the umbo. The whole is rather thick and solid, and the antero-posterior length of the fragment is 6.5 millimeters.

Type locality.—Bowden, Jamaica.

The holotype—the anterior part of a left valve—is the only specimen of this species. It fails to give a definite idea of the shape of the shell. It probably is a *Martesia* rather than a *Teredina,* a genus that occurs only in Eocene deposits. The sculpture is similar to that of many species of *Martesia,* but the anterior threads are more distinctly beaded. The callus concealing the anterior gape is very thick and its

edge extends to the umbo under a thin deposit of shell material. The callus over the umbo completely conceals the umbo when viewed from the interior. If the shell had any myophore it is broken.

Type material.—Holotype (left valve, U. S. Nat. Mus. No. 135737).

Genus XYLOPHAGA Turton.

Turton, 1822, Conchylia Insularum Britannicarum, p. 253.

Type (by monotypy).—Teredo dorsalis Turton. Recent, seas of Europe.

The following is a description of the shell of the genus *Xylophaga:*

Shell medium-sized, spherical, posterior end widely gaping; a wide, deeply channeled groove extends from the umbo to the ventral margin at the anterior end of the gape; posterior part of shell sculptured with fine oblique threads, angulated along an oblique line; umbos covered with two united shelly plates; myophore absent.

Several doubtful species of these wood-boring mollusks are recorded from American Tertiary deposits.

Xylophaga ? species.

(Plate 26, Figure 18.)

The anterior part of a right valve in the U. S. National Museum referred to by Dall, may be a *Xylophaga,* but its features are indeterminable. The groove extending from the umbo to the ventral margin is wide and deeply channeled. The part of the shell in front of the groove is sculptured with incrementals. There is only a small piece of the part of the shell in back of the groove preserved. It is worn and its sculpture is obscure.

Family TEREDIDAE.

Genus TEREDO Linné.

Linné, 1758, Systema Naturae, ed. 10, p. 651.

Type (by subsequent designation, Gray, 1847).—Teredo navalis Linné. Recent, northern seas of Europe.

Toredo ? species.

Pieces of calcareous tubes probably are tubes of *Teredo* or one of its allies, but no shells have been found. They are much smaller and thinner than tubes from the Dominican Republic to which Gabb gave the name *Kuphus incrassatus.* It is a common practice to call Tertiary tubes *Teredo,* whether they are associated with wood or not. Living species of *Teredo* make their home in wood. Species of *Kuphus* Gray are said to bore in sand and silt. Many of the Tertiary tubes may represent *Kuphus.* Large tubes, similar to the Dominican *Kuphus incrassatus,* are remarkably abundant in the Tertiary (Eocene to Miocene) limestones of the West Indies and Central America, especially in Anguilla, Porto Rico, Haiti, Cuba, Jamaica, and Guate-

mala. According to available evidence these limestones were deposited in seas to which no detritus-bearing streams had access. Therefore it is not likely that these numerous tubes dropped from rotting wood.

Bartsch[1] has recently published a critical monograph of the American species of *Teredo* and its allies, all of which are wood-borers. The genera and subgenera are based principally on features of the pallets, which have never been found in a fossil state.

[1] P. Bartsch. A monograph of the American shipworms: U. S. Nat. Mus. Bull., 122, 51 pp. 37 plates, 1 text-fig. 1922.

Class SCAPHOPODA.

Family DENTALIIDAE.

Genus DENTALIUM Linné.

Subgenus DENTALIUM s. s.

Section DENTALIUM s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 785.

Type (by subsequent designation, Gray, 1847).—Dentalium elephantinum Linné. Recent, Amboyna and Philippine Islands.

The following is a description of the section *Dentalium* s. s.:

Shell medium-sized or large, strongly curved, rapidly enlarging; sculpture consisting of strong longitudinal ribs; the type species usually has 10 (9 to 11) primary ribs, but except at the posterior end several secondary ribs lie in the interspaces; other species have a varying number (4 to 14) of primary ribs, increased by the addition of secondary ribs; the type species has a shallow notch on the convex side of the apex; other species have an unnotched apex.

Many subgenera of *Dentalium,* based principally on apical features, have been described. Although some of them probably are artificial, they serve a useful purpose in separating a large group. The usage of these subgenera as established by Pilsbry and Sharp[1] and by Henderson,[2] is here followed. Large or medium-sized species of *Dentalium* having strong longitudinal ribs, and a shallow notch on the convex side of the apex or no notch, usually are placed in the subgenus *Dentalium* s. s. Tertiary and living species of such Dentalia have a virtually cosmopolitan distribution. Most of the living species inhabit shallow water.

Key to the Bowden species of Dentalium s. s.

Secondary ribs absent or very obscure.
- Primary ribs 6..... *D.* (*D.*) *cossmannianum*
- Primary ribs 8..... *D.* (*D.*) *glaucoterrarum*
- Primary ribs 9..... *D.* (*D.*?) species a

Secondary ribs present, primary ribs 8..... *D.* (*D.*?) species b

Dentalium (Dentalium) cossmannianum Pilsbry and Sharp.

(Plate 27, Figures 1, 2.)

Dentalium dissimile var Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 244.

Dentalium cossmannianum Pilsbry and Sharp, 1898, Proc. Acad. Nat. Sci. Philadelphia, vol. 49, pp. 467–468, plate 10, fig. 11, plate 11, figs. 10, 11. Pilsbry and Sharp, 1898, Man. Conch., ser. 1, vol. 17, p. 202. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 323, plate 52, fig. 3. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 399.

The following is the original description of this species:

Shell a hexagonal prism with slightly convex faces, slender, slowly tapering, moderately solid, glossy. Sculpture: there are 6 very narrow equidistant longitudinal threads, well raised and sharply defined, the wide intervals

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[1] H. A. Pilsbry, and B. Sharp. Scaphopoda: Manual of Conchology, ser. 1, vol. 17. 1897–98.

[2] John B. Henderson. A monograph of the East American Scaphopod mollusks: Bull. U. S. Nat. Mus. 111, 1920.

between them flat on the smaller end of the shell, but becoming decidedly convex toward the larger end; circular sculpture of rather strongly impressed annular growth marks at unequal intervals, sometimes close, sometimes distant. Aperture not preserved in the material before us, but apparently not oblique and with nearly circular peristome but slightly modified in shape by the longitudinal threads. Apex not known, but evidently hexagonal. Length of (broken) type specimen, 23 mm.; greatest diameter at larger end, 3.5, at smaller end, 2.7.

Type locality.—Dominican Republic.

This species is represented by a number of small broken pieces. At irregular intervals the growth-lines are very strong. The absence of secondary ribs is a characteristic feature. According to the collections of the U. S. Geological Survey expedition this species is confined to the Gurabo formation in the Dominican Republic.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 2709).

Dentalium (Dentalium) glaucoterrarum Maury.

(Plate 27, Figures 3, 4.)

Dentalium glaucoterrarum Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 323, plate 52, fig. 4.

The following is the original description of this species:

Shell with 8 equal, distant, raised longitudinal ribs, intervals slightly convex, marked by irregularly spaced circular growth lines; interstitial riblets entirely absent or extremely weak. Length of fragment, 23 mm.; diameter of larger end, 4 mm.; of smaller, 3 mm.

Type locality.—Zone E, Rio Gurabo at Los Quemados, Dominican Republic.

This species, which is represented by several broken pieces, is similar to *D. cossmannianum,* but has 8 ribs. At unequal intervals the growth-lines are strong like in *D. cossmannianum.* Some specimens from both Jamaica and the Dominican Republic have obscure secondary ribs. This species is fairly abundant in Cercado formation, but only a few specimens have been collected from the Gurabo formation.

Other localities.—Cercado (lower Miocene) and Gurabo (middle Miocene) formation, Dominican Republic.

Type material.—Cornell University.

Dentalium (Dentalium?) species a.

(Plate 27, Figures 5, 6.)

A small broken *Dentalium* resembles *D. cossmannianum* and *D. glaucoterrarum,* but has 9 ribs. The interspaces are smooth except for irregularly spaced growth lines. The ribs are narrow and high, making the interspaces convex, like on the posterior part of *D. cossmannianum* and *D. glaucoterrarum.* This broken specimen probably represents a new species that may be an *Antalis* or a *Dentalium* s. s.

Dentalium (Dentalium ?) species b.

(Plate 27, Figures 7, 8.)

Several small broken tubes have 8 primary ribs and 1 or 2 secondary ribs in each interspace. At the anterior end of the largest piece the secondary ribs are almost as strong as the primaries. This species may be an *Antalis*.

Section TESSERACME Pilsbry and Sharp.

Pilsbry and Sharp, 1897, Manual of Conchology, ser. 1, vol. 17, p. 249.

Type (*by monotypy*).—*Dentalium quadrapicale* Sowerby. Recent, Cochin and Malabar, Eastern seas.

The following is a description of the section *Tesseracme:*

Shell medium-sized; apex quadrangular, a low primary rib at each angle; the angles soon disappear and a progressively larger number of secondary ribs are added on the circular posterior two-thirds of the shell; apex unnotched.

This curiously sculptured group of scaphopods has an interesting history similar to that of many other West Indian Miocene mollusks. Though represented in the West Indies by the Miocene *D. dissimile* and in Florida by the Pliocene *D. caloosaënae* Dall, there are no living Atlantic species. All the known living species are confined to tropical and subtropical Pacific waters. Pilsbry and Sharp have already traced the history of this section.

Key to the Bowden subspecies of Tesseracme.

Shell moderately thick..... *D.* (*T.*) *dissimile dissimile*
Shell very thick..... *D.* (*T.*) *dissimile ponderosum*

Dentalium (Tesseracme) dissimile dissimile Guppy.

(Plate 27, Figures 9 to 14.)

Dentalium dissimile Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 292, plate 17, fig. 4. Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 244. Guppy, Geol. Mag., dec. 2, vol. 1, p. 440 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32. p. 517. Pilsbry and Sharp, 1898, Proc. Acad. Nat. Sci., Philadelphia, vol. 49, pp. 469–470, plate 11, figs. 3 to 5. Pilsbry and Sharp, 1898, Man. Conch., ser. 1, vol. 17, p. 203. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 322, plate 52, fig. 1. Pilsbry, 1922, Proc. Acad. Nat. Sci., Philadelphia, vol. 73, p. 400.

Dentalium (*Tesseracme*) *dissimile* Guppy, Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 166.

The following is the original description of this subspecies:

Shell subpolygonal and striated at the apex, becoming gradually round, smooth, and shining near the aperture, which is circular.

Type locality.—Jamaica.

The following supplements the original description of this subspecies:

Shell medium-sized, thick, slightly curved; apex rectangular, the angles elevated into low rounded ribs that soon disappear leaving the anterior

two-thirds of the shell circular; near the apex a secondary median rib lies on each face of the shell; a little farther toward the anterior end 1 to 4 other secondary ribs may appear; the secondary ribs disappear before the primaries and the anterior two-thirds of the shell is smooth except for obscure growth lines.

Length 51 mm.; exterior diameter of aperture 4.5 mm.; arc[1] 2 mm. (tip broken).

D. dissimile dissimile and *D. dissimile ponderosum* Gabb are the largest and most abundant Bowden scaphopods. The secondary sculpture near the apex varies in sharpness of detail. As Pilsbry and Sharp have noted, the specimen figured by Guppy has only a small part of the sculptured anterior part of the shell. The shell figured on plate 27, figure 9, is not perfect, as a small part of the posterior end is broken. The shell is larger, much thicker, and more uniformly curved than in the type species of the section. It closely resembles *D. tesseragonum* Sowerby, a smaller species on the Pacific coast of Central America.

D. dissimile dissimile is represented by many specimens in the Cercado formation of the Dominican Republic and by fewer specimens in the Gurabo formation.

Other localities.—Cercado (lower Miocene) and Gurabo (middle Miocene) formations, Dominican Republic.

Type material.—Holotype, British Museum (Natural History), Geological Department, No. 64082.

Dentalium (Tesseracme) dissimile ponderosum Gabb.

(Plate 27, Figures 15 to 17.)

Dentalium ponderosum Gabb, 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, p. 244.

Dentalium dissimile var. *ponderosum* Gabb, Pilsbry and Sharp, 1898, Proc. Acad. Nat. Sci. Philadelphia, vol. 49, p. 470, plate 10, figs. 1 to 3, plate 11, figs. 15, 16. Pilsbry and Sharp, 1898, Man. Conch., ser. 1, vol. 17, p. 203. Maury, 1917, Bull. Amer. Paleontology, vol. 5, pp. 322–323, plate 52, fig. 2.

Dentalium dissimile ponderosum Gabb, Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 400.

The following is the original description of this subspecies:

Shell elongate, slender, very slightly arcuate, the greater curve being at the tip; surface with a few longitudinal ribs at the apex, which become obsolete as the shell grows older; beyond these there are no ornaments except the faint lines of growth. Internally the shell is thickened by deposition of shelly layers so as to reduce the internal diameter to a fourth of the external.

Type locality.—Dominican Republic.

Length 46 mm.; exterior diameter of anterior end 5 mm.; arc. 1.2 mm. (both ends broken).

[1] Following Henderson the "arc" is a measure of curvature expressed by the distance from a line joining the apex and aperture to the highest point in the concave arch of the lower surface of the shell.

This subspecies is larger than *D. dissimile dissimile* and its sculpture disappears more rapidly. Its shell is remarkably thick, leaving only a narrow space for the animal, except at the aperture where the shell is thin. The contrast between *D. dissimile ponderosum* and *D. dissimile dissimile* afforded by this feature is strikingly shown by the sections, figures 13, 14, 16, and 17 on plate 27. The figured specimen of *D. dissimile ponderosum* is broken at both ends and all the sculptured part is lost.

In the collections from Bowden this subspecies is less abundant than *D. dissimile dissimile.* It is represented in both the Cercado and Gurabo formations of the Dominican Republic, but like *D. dissimile dissimile* is more abundant in the Cercado formation.

Other localities.—Cercado (lower Miocene) and Gurabo (middle Miocene) formations, Dominican Republic.

Type material.—Holotype, Philadelphia Acad. Nat. Sci. No. 2708.

Subgenus GRAPTACME Pilsbry and Sharp.

Pilsbry and Sharp, 1897, Manual of Conchology, ser. 1, vol. 17, p. 85.

Type.—Dentalium eboreum Conrad. Recent, southeastern United States and the West Indies.

The following is a description of the subgenus *Graptacme:*

Shell small or medium-sized, slender, moderately curved, circular in section; part of shell near apex sculptured with very fine crowded longitudinal riblets, remainder of shell smooth; apex having a narrow notch on convex side.

Dentalium eboreum is herewith designated the type as none has been designated.

As used by Pilsbry and Sharp, the subgenus *Graptacme* includes small or medium-sized, slender species having very fine longitudinal riblets near the apex. These species have a variety of apical features. Some species have a simple apex; others have a slit apical plug; others have a shallow notch; and others have a slit that is on the convex side, or on the concave side, or lateral in position. The living species are mainly shallow-water dwellers or live at moderate depths. They are confined to east and west American waters and to the Indo-Pacific region.

Key to the Bowden species of Graptacme.

Apex having a shallow lateral notch, riblets moderately crowded.....*D.* (*G.*) species a
Apex having a deep slit on concave side, riblets very much crowded...*D.* (*G.*) species b

Dentalium (Graptacme) species a.

Two small broken shells in the Henderson collection (U. S. Nat. Mus. No. 135534) represent a species of *Graptacme.* These shells are very slender, circular in section, moderately thick, and slightly arched. The part near the apex is sculptured with very fine longitudinal

riblets that soon disappear, leaving most of the shell smooth. The smaller of these two pieces has a wide shallow lateral notch.

Dentalium (Graptacme) species b.

Another small species of *Graptacme* is represented by an apical piece in the Henderson collection (U. S. Nat. Mus. No. 135535). This species has even finer and more closely spaced longitudinal riblets than species *a*. The apex has a long slit, probably on the concave side, but the shell is so small and the curvature so slight that the position of the slit is doubtful. So far as it goes, this fragment is similar to *D.* (*G.*) *amaliense* Henderson, a living species from St. Thomas, but has a larger slit and more closely spaced riblets. The slit seems to be unusually long for the subgenus *Graptacme*.

Subgenus LAEVIDENTALIUM Cossmann.

Cossmann, 1888, Catalogue Illustré des Coquilles Fossiles de l'Eocène des Environs de Paris, part 3, p. 11.

Type (*by original designation*).—*Dentalium incertum* Deshayes. Eocene, Paris Basin.[1]

The following is a description of the subgenus *Laevidentalium:*

Shell small, slightly arched, slender, section slightly oval; surface polished, smooth except for obscure growth lines; apex unnotched.

This subgenus has been expanded by Pilsbry and Sharp to serve as a convenient division for small or large, circular or subcircular, smooth species having no apical notch or having a shallow notch on the convex side, as in some species of *Antalis*.

Dentalium (Laevidentalium) haytense Gabb.

(Plate 27, Figures 18 to 20.)

Dentalium haytensis Gabb, 1873, Trans. Amer. Philos. Soc. n. s., vol 15, p. 244. Pilsbry and Sharp, 1898, Proc. Acad. Nat. Sci. Philadelphia, vol. 49, pp. 471–472, plate 11, figs. 8, 9. Pilsbry and Sharp, 1898, Man. Conch. ser. 1, vol. 17, p. 205. Maury, 1917, Bull. Amer. Paleontology, vol. 5, p. 323. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 400.

? *Dentalium* (*Rhabdus*) sp. undet., Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 168.

The following is the original description of this species:

Shell small, nearly straight, increasing gradually in size, surface polished.

Type locality.—Dominican Republic.

The following is a description of specimens from Bowden:

Shell medium-sized, slender, slightly arched, section circular; surface smooth; on polished shells obscure growth-lines are visible passing around the shell in a slightly oblique direction; apical features not known.

D. haytense is an almost featureless species represented by broken pieces resembling similar pieces from the Cercado and Gurabo forma-

[1] I have not seen authentic specimens of the type species. The description is taken from Cossmann.

tions of the Dominican Republic. Like most of the other species of *Dentalium* it is more abundant in the Cercado formation than in the Gurabo. It is the only smooth circular *Dentalium* from Bowden. The largest piece has a diameter of 3 mm.

Other localities.—Cercado (lower Miocene) and Gurabo (middle Miocene) formations, Dominican Republic.

Type material.—Holotype, Philadelphia, Acad. Nat. Sci. No. 2715.

Subgenus EPISIPHON Pilsbry and Sharp.

Pilsbry and Sharp, 1897, Manual of Conchology, ser. 1, vol. 17, p. 117.

Type.—Dentalium sowerbyi Guilding. Recent, southeastern United States and West Indies.

The following is a description of the subgenus *Episiphon:*

Shell small, very slender, needle-like, circular, moderately curved; surface smooth except for growth rings that are most conspicuous on posterior part of shell; apex having a short projecting tube or a wide shallow U-shaped lateral notch.

As no type species has been designated, *Dentalium sowerbyi* Guilding, fully described by Henderson, is herewith designated the type.

Pilsbry and Sharp used this subgenus to include small, thin, needle-shaped species of *Dentalium* having no longitudinal sculpture. The apical tube, which may not be a feature of biologic significance, is absent even on many specimens of the type species and is not confined to species included in this subgenus. Most of the living species of *Episiphon* are deep-water dwellers.

Key to the Bowden species of Episiphon.

Posterior part of shell sculptured with coarse growth rings, section elliptical.
D. (E.) schumoi

Posterior part of shell not sculptured with coarse growth rings, section ovate.
D. (E.) macilentum

Dentalium (Episiphon) schumoi Pilsbry.

(Plate 27, Figures 21 to 23.)

Dentalium (Episiphon) schumoi Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 167, fig. 5.

The following is the original description of this species:

Shell small, slightly curved, excessively slender, the adults but slightly tapering, young shells acicular; rather thin; surface finely striated circularly, becoming on the posterior half strongly annulated by rather regularly spaced, close grooves, slightly oblique, and cutting the surface into narrow segments much as in *D. (Fustriaria) circinatum.* Tube strongly compressed laterally throughout; apex simple or without a short projecting pipe or tube. Length 8.2, antero-posterior diameter at aperture 0.78, at apex 0.56 mm.; lateral diameter at aperture 0.6, at apex 0.46 mm. The specimen has evidently lost in length by breakage.

Type locality.—Bowden, Jamaica.

The coarse growth rings on the posterior part of the shell and the lateral compression are characteristic features of this small, needle-shaped species. Some specimens have a broad U-shaped lateral notch similar to the notch on some specimens of *D. sowerbyi,* but deeper. A specimen figured by Pilsbry has an apical tube.

Type material.—Holotype, Philadelphia Acad. Nat. Sci. No. 653.

Dentalium (Episiphon) macilentum Pilsbry.

(Plate 27, Figures 24, 25.)

Dentalium (Episiphon) macilentum Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 166–167, figs. 1, 2.

The following is the original description of this species:

Shell small, moderately curved, excessively slender, slightly tapering; surface smooth, somewhat glossy, with slight growth-lines only. Tube very strongly compressed laterally throughout, wider and thicker along the concave than the convex side. Both apertures oval or oblong. Young stage acicular. Dimensions of largest (though imperfect) specimen: Length 8.8, antero-posterior diameter at aperture 9.1, at apex 0.7 mm.; lateral diameter at aperture 0.7, at apex 0.6 mm.

Type locality.—Bowden, Jamaica.

This small species, which is represented by many specimens, seems to be a laterally compressed *Episiphon.* Most of the specimens are more compressed at the posterior end than at the anterior end. The apex of one small specimen shows the base of a projecting tube that has been broken. The concave side of the shell is wider than the convex, producing an ovate section. *D. macilentum* is slightly larger than *D. schumoi* and lacks the coarse growth rings.

Type material.—Holotype, Philadelphia Acad. Nat. Sci. No. 654.

Family SIPHONODENTALIIDAE.

Genus CADULUS Philippi.

Subgenus CADULUS s. s.

Philippi, 1844, Enumeratio Molluscorum Sicilae, vol. 2, p. 209.

Type (by monotypy).—Dentalium ovulum Philippi. Recent, Mediterranean Sea.

The following is a description of the subgenus *Cadulus* s. s., adapted from Pilsbry and Sharp:

Shell small, short, stout, cask-shaped, strongly inflated medially; aperture and apex subcircular; apical opening not slit, contracted by a ledge inside the opening.

The subgenera of the genus *Cadulus,* as used by Pilsbry and Sharp and by Henderson, are based principally on apical features. As only a few Bowden specimens show apical features they are classified mainly on shape and similarity to living species. Species of the subgenus *Cadulus* s. s. are characterized by their swollen outline, both the dorsal and ventral sides being convex, and by their unslit apex.

The Bowden species here described seems to be the only described American Tertiary *Cadulus* s. s. The living species are confined to the North Atlantic and adjoining seas.

Cadulus (Cadulus) simrothi Pilsbry.

(Plate 28, Figure 1.)

Cadulus simrothi Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 168–169, fig. 3.

The following is the original description of this species:

Shell minute, smooth, slightly arcuate, biconic, strongly swollen in the middle, rapidly tapering towards both ends, produced in a short tube posteriorly; greatest diameter contained about 2⅓ times in the length of the shell. Outline of the most convex side irregular, the contours being but slightly convex above and below the "equator," and sometimes a little concave near the posterior orifice; outline of the opposite side similar, but less convex. Tube circular in section at "equator" and aperture, decidedly oval at posterior or anal orifice, being compressed on the convex and less on the concave side. Aperture much larger than the other orifice, oblique, the peristome thin. Anal orifice oval, decidedly wider than long, obstructed by a circular callus within; edges unslit. Length 2.1 mm.; diameter at aperture 0.37, at greatest swelling 0.9 mm.; antero-posterior diameter at apex 0.27, lateral diameter 0.3 mm.

Type locality.—Bowden, Jamaica.

The dorsal side of this species is more evenly convex than the ventral side, which bulges at the equator. This little species, represented by only a few specimens, is similar to *C. exiguus* Watson and *C. obesus* Watson, living West Indian species, but is more inflated than *C. exiguus* and smaller than *C. obesus*. There is a similar stouter undescribed species in the Gurabo formation of the Dominican Republic.

Type material.—Holotype, Philadelphia Acad. Nat. Sci. No. 650.

Subgenus GADILA Gray.

Section GADILA s. s.

Gray, 1847, Proceedings Zoological Society of London, part 15, p. 159.

Type (by original designation).—Dentalium gadus Montagu. Recent. According to Pilsbry and Sharp, the habitat of this species is uncertain. Montagu gives "many parts of the British channel."

The following is a description of the section *Gadila:*

Shell small, moderately slender, curved, the dorsal side convex, the ventral side concave, swollen between middle of shell and aperture; surface smooth except for inconspicuous growth lines; apical opening small, unslit.

The subgenus *Gadila* resembles *Cadulus* s. s. in having an unslit apex, but the shell is more slender and more curved. The section *Gadila* s. s. is further characterized by its moderately slender outline and absence of pronounced sculpture. There are no Bowden species of *Gadila* s. s.

Section GADILOPSIS, new section.

Type.—Ditrupa dentalina Guppy. Miocene, Jamaica.

The following is a description of the section *Gadilopsis:*

Shell moderately small, very slender, needle-shaped, slightly swollen very near aperture; sculpture consisting of oblique growth rings on posterior part of shell; apical opening small, unslit.

The geologic history and present distribution of this section, as traced by Pilsbry and Sharp, seem to fully justify their suggestion that the group of *C. dentalinus* should probably form a separate section. The needle-shape, slight swelling very near the aperture, and sculpture separate *Gadilopsis* from *Gadila* s. s. The living species of sculptured *Gadilopsis* are confined to the West Indian and adjoining waters, the Pacific coast of Central American and Mexico, and the East Indies. Pilsbry and Sharp expand the group to include similarly shaped smooth species.

Key to the Bowden species of Gadilopsis.

Shell very slender, growth rings crowded..... *C. (G.) dentalina*
Shell relatively stout, growth rings not so crowded..... *C. (G.) hendersoni*

Cadulus (Gadilopsis) dentalinus (Guppy).

(Plate 28, Figures 2, 3.)

Ditrupa dentalina, Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, part 10, pp. 87–88, plate 1, fig. 11. Guppy, 1874, Geol. Mag., dec. 2, vol. 1, plate 16, fig. 11. Guppy, 1875, Geol. Mag. dec. 2, vol. 2, p. 42.

Cadulus dentalinus (Guppy), Pilsbry and Sharp, 1898, Man. Conch. ser. 1, vol. 17, p. 190, plate 36, figs. 21, 22. Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 168.

The following is the original description of this species:

Tube clavate, curved, slightly irregular in diameter, gradually increasing from the smaller end, which is annulate, becoming smooth towards the middle of the shell; the lower half smooth, shining, rather suddenly thickened near the aperture, to form which it as suddenly contracts to a diameter not greater than that of the smaller third of the tube.

Type locality.—Jamaica.

The following supplements the original description of this species:

Shell small, needle-shaped, moderately curved, abruptly inflated very near aperture, then abruptly sloping to aperture, slightly flattened dorso-ventrally, especially the posterior half; slightly less than posterior half sculptured with closely set oblique growth-rings that gradually disappear and become less crowded toward anterior end; aperture thin, subcircular; apical opening small, subelliptical.

Length 7 mm.; greatest diameter 1 mm.

Guppy's figure is unrecognizable. The type material consists of 5 specimens, only 2 of which represent this species. One of these specimens is figured. This species closely resembles *C. acus* Dall, a shallow-water species from the Gulf of Mexico and the West Indies, and *C. panamensis* Pilsbry and Sharp, from the Pacific coast of Central

America. It is a little stouter and more abruptly swollen than *C. acus,* and more slender than *C. panamensis.*

Cadulus phenax Pilsbry and Sharp, from the Cercado formation of the Dominican Republic, has the same general features, but is less abruptly swollen near the aperture and has less conspicuous growth-rings. An undescribed species from the Gurabo formation of the Dominican Republic more closely resembles *C. dentalinus,* but is a little stouter.

Type material.—5 cotypes, only 2 of which represent this species (U. S. Nat. Mus. No. 115607).

Cadulus (Gadilopsis) hendersoni, new species.

(Plate 28, Figure 4.)

The following is a description of this species:

Shell medium-sized, moderately slender, moderately curved, gradually inflated near aperture, slightly flattened dorso-ventrally, especially posterior half; posterior half or less sculptured with relatively distant growth-rings; aperture subcircular; apical opening subelliptical.

Length 10 mm.; greatest diameter 1.7 mm.; diameter of aperture 1.1 mm.; larger diameter of apical opening 0.5 mm.

This species, represented only by the holotype, is larger and stouter than *C. dentalinus* and has less crowded growth-rings on the sculptured part. It resembles *C. panamensis* Pilsbry and Sharp, but is a little stouter.

Type material.—Holotype (U. S. Nat. Mus. No. 352724).

Subgenus POLYSCHIDES Pilsbry and Sharp.

Pilsbry and Sharp, 1897, Manual of Conchology, ser. 1, vol. 17, p. 146.

Type (by original designation).—Cadulus tetraschitus Watson. Recent, Brazil.[1]

The following is a description of the subgenus *Polyschides:*

Shell small, moderately slender, moderately curved, greatest swelling near middle, slightly contracted near aperture; surface smooth except for growth-lines; apex having 4 relatively deep notches.

The relatively deep notches are characteristic features of this subgenus. Pilsbry and Sharp extend its limits to include species having more than 4 notches. The living species are most abundant in the Atlantic.

Cadulus (Polyschides) annulatus Pilsbry.

(Plate 28, Figures 5, 6.)

Cadulus annulatus Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 168.

The following is the original description of this species:

Rather a large, slender species of the group of *C. dentalinus.* The swelling is only slight and near the anterior end; tube subcircular in section,

[1] I have not seen the type species. The description is based on *C. quadridentatus* Dall.

a trifle flattened on the convex side at oblique aperture; sculpture of very fine, close, oblique wrinkles throughout. The length is about 7.5 mm.; greatest diameter, 1 mm.

Type locality.—Bowden, Jamaica.

The following supplements the original description of this species:

Shell moderately small and slender, greatest swelling at about anterior fourth of length, posterior half and aperture slightly flattened dorso-ventrally; sculpture consisting of very fine oblique rings, obscured by growth-lines on posterior half; apex having 2 moderately deep notches, one on each side near the concave side, and probably 2 shallower notches near the convex side.

Length 8 mm.; greatest diameter 1.4 mm.

This species is not similar to *C. dentalinus,* as it is not abruptly inflated near the aperture and has different apical features. The broken apex of the specimen figured has only 2 notches, but as they are not at the middle of the sides, but near the concave side, it is not likely that this species is a *Dischides.* There are traces of 2 other shallower notches. The fine rings, which are most prominent on the anterior part of the shell, are a striking feature. Apparently they are not growth-rings, but actual sculpture.

Type material.—Holotype, Philadelphia Acad. Nat. Sci. No. 649.

Subgenus PLATYSCHIDES Henderson.

Henderson, 1920, U. S. Nat. Mus. Bull. 111, p. 104,

Type (by original designation).—Cadulus grandis Verrill. Recent, east Atlantic north of Hatteras.

The following is a description of the subgenus *Platyschides:*

Shell relatively large, moderately curved, greatest swelling between middle and aperture, posterior part and aperture flattened dorso-ventrally; surface smooth and polished; apex having 4 broad very shallow notches.

Henderson extended the limits of this subgenus to include species having only 2 shallow apical notches. In all the species the notches are shallower than in *Polyschides.* This subgenus includes many Tertiary and living species.

Key to the Bowden species of Platyschides.

Dorsal surface compressed near aperture..... *C. (P.) depressicolis*
Dorsal surface not compressed near aperture
  Shell relatively large.
    Greatest inflation near middle, rapidly tapering to aperture..... *C. (P.) pilsbryi*
    Greatest inflation nearer aperture, not rapidly tapering to aperture.. *C. (P.)* species
  Shell small.
    Shell compressed dorso-ventrally..... *C. (P.) annectens*
    Shell not compressed dorso-ventrally..... *C. (P.) arrosus*

Cadulus (Platyschides) depressicolis Pilsbry and Sharp.

(Plate 28, Figures 7 to 9.)

Gadus dominguensis Gabb, 1873, (part, not d'Orbigny), Trans. Amer. Philos. Soc., n. s., vol. 15, p. 245.

Cadulus depressicolis Pilsbry and Sharp, 1898, Proc. Acad. Nat. Sci. Philadelphia, vol. 49, pp. 473–474, plate 11, figs. 25 to 27. Pilsbry and Sharp, 1898, Mam. Conch. ser. 1, vol. 17, p. 236. Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 168. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 401.

The following is the original description of this species:

Shell long and slender, arcuate, much compressed between the concave and convex sides throughout. Regularly and slowly enlarging from the apex nearly to the aperture, then noticeably contracted on all sides; on the middle of the convex side having a distinctly compressed, concave area about one-third the width of the shell, and extending from the peristome backward a distance about equal to the greatest diameter of the aperture; surface smooth and glossy. Aperture oblong; apex oblong, simple, with subcircular orifice. Length 11.75 mm.; greatest diameter of tube 1.63, least diameter at same point 1.25 mm.; aperture, greatest diameter, 1.06; least, 0.8 mm.

Type locality.—Dominican Republic.

All the Bowden specimens are broken. The one figured represents about the anterior two-thirds of a shell. One specimen examined has indications of 4 unsymmetrically arranged shallow apical notches, but they may not actually be notches. The depressions on the convex side near the aperture is a striking feature, apparently not represented in any living species. The dorsal surface of *C. poculum* Dall, a living West Indies species, is remarkably flattened near the aperture, but not actually depressed.

The holotype in the Gabb collection is the only known specimen from the Dominican Republic. Its age is not known.

Other localities.—Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 2884).

Cadulus (Platyschides) pilsbryi, new species.

(Plate 28, Figure 10.)

The following is a description of this species:

Shell moderately large, moderately stout, gently curved, greatest inflation between middle and anterior end, rapidly tapering to aperture, posterior and anterior parts moderately flattened dorso-ventrally; surface smooth and polished; aperture oblique, elliptical; apical features not known.

Length 8 mm. (without tip); greatest diameter 2 mm.; greatest diameter of aperture 1.2 mm.

C. pilsbryi is represented by a number of broken specimens. Its greatest inflation is more posterior than in *C. depressicolis;* the shell is less flattened, and the dorsal surface is not depressed near the aperture. It closely resembles *C. agassizi* Dall, a living species from

the southeastern coast of the United States, but is more flattened and tapers more rapidly to the aperture. The greatest inflation is more posterior than in *C. thallus* Conrad, a Miocene species from the Atlantic States, and the curvature is greater.

Type material.—Holotype, U. S. Nat. Mus. No. 352726.

Cadulus (Platyschides) species.

An imperfect specimen in the U. S. National Museum collection (No. 61568) represents a moderately large *Platyschides* that is more slender than *C. pilsbryi,* and its greatest inflation is more anterior. It is more flattened than *C. agassizi* Dall.

Cadulus (Platyschides) annectens, new species.

(Plate 28, Figure 11.)

The following is a description of this species:

Shell small, slender, slightly curved, greatest inflation near middle, gradually tapering toward aperture, then abruptly constricted at aperture, flattened dorso-ventrally, especially in posterior part; surface smooth and polished, but obscure growth-marks are visible on parts of shell; aperture subcircular; apical features not known.

Length 5 mm.; greatest diameter 1.2 mm.; diameter of aperture 0.6 mm.

This small species, which may be a *Polyschides,* is represented only by the holotype. It is much larger than *C. colobus* Pilsbry and Sharp from the Cercado formation of the Dominican Republic, and its anterior part is more inflated. The rapid taper at the aperture is a characteristic feature of *C. annectens.*

Type material.—Holotype (U. S. Nat. Mus. No. 353077).

Cadulus (Platyschides) arrosus, new species.

(Plate 28, Figure 12.)

The following is a description of this species:

Shell small, slender, slightly curved, greatest inflation rather abrupt at about anterior third of length; section subcircular except at aperture; surface smooth and polished; aperture slightly oblique, laterally subelliptical; apical features not known.

Length 5.5 mm.; greatest diameter 1.2 mm.; greatest diameter of aperture 0.7 mm.

This species, also known only from the holotype, is the only circular Bowden *Platyschides,* although the aperture is subelliptical. In general features it resembles the living West Indian *C. portoricensis* Henderson, but is smaller and its inflation is more abrupt. It is smaller than *C. denticulus-tigris* Maury, from the Cercado formation of the Dominican Republic, and its greatest inflation is more anterior.

Type material.—Holotype (U. S. Nat. Mus. No. 353078).

NOTE.

Doctor Maury's report describing Miocene mollusks from Trinidad[1] was distributed when the page proof of this report was ready for the printer. The only copy available at the present time is imperfect, as pages 211 to 218 are missing. As Doctor Maury states, the Miocene deposits of Trinidad contain very few Bowden species. The record of *Leda peltella* Dall from the *Cadulus* bed on the Corosal road is based on Guppy's record of *Leda acuta* Gabb. As no specimens from this locality are in the Guppy collection at the United States National Museum, this record can not be confirmed. The same statement applies to *Corbula heterogena* Guppy, recorded by Guppy from the same locality. What Maury calls *Glycymeris jamaicensis* Dall, from a locality near Machapoorie, has radial ribs that are too strong for *jamaicensis*. *Glycymeris jamaicensis machapoorensis* Maury is very similar to *Glycymeris jamaicensis jamaicensis*, as is shown by specimens in the United States National Museum from Machapoorie quarry, the type locality. A worn shell from a locality near Brasso is identified as *"Scapharca" inaequilateralis* Guppy, but a shell from the Dominican Republic is figured. *Ostrea messor* Maury is similar to the species here described as *O. paramegodon*, but is more like *O. megodon* Hanley. Specimens of *Crassinella guppyi* Dall from Springvale in the United States National Museum, like the specimen figured by Maury, are not quite so inflated as specimens from Bowden and have fewer coarse lamellae. The left valve of *Chama involuta* Guppy from Brasso Creek has essentially the same kind of sculpture as shells from Bowden, but is more equilateral. Similar poorly preserved shells from Machapoorie quarry are in the United States National Museum. In addition to these species Maury describes a number of Bowden shells that have never been found in Trinidad.

Doctor Maury renames *Pecten vaughani* Cooke 1919 and *Pecten vaughani flabellum* Cooke 1919 (not *Pecten* (*Lyropecten*) *vaughani* Arnold 1906), although Doctor Cooke had already renamed them.[2]

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[1] Carlotta Joaquina Maury, March 27, 1925. A further contribution to the paleontology of Trinidad; Miocene horizons. Bull. Amer. Paleontology, vol. 10, pp. 152-402, pls. 12 to 54.

[2] C. Wythe Cooke, 1921. New names for West Indian Tertiary Pectens. Nautilus, vol. 34, No. 4, p. 137.

DESCRIPTIONS OF PLATES.

(Unless otherwise designated all specimens are from Bowden, Jamaica.)

PLATE 1.

FIG. 1. *Nucula* (*Nucula*) *morantensis*, n. sp. Exterior of left valve of holotype (both valves in attached position), × 4; U. S. Nat. Mus. No. 352727; page 13.

FIGS. 2, 3. *Nucula* (*Nuculopsis*) *hilli*, n. sp. Holotype (right valve), × 2; (2) exterior and (3) interior of same specimen; U. S. Nat. Mus. No. 352728; page 14.

FIGS. 4, 5. *Leda* (*Saccella*) *peltella* Dall. Holotype (right valve), × 4; (4) exterior and (5) interior of same specimen; U. S. Nat. Mus. No. 135753; page 16.

FIGS. 6, 7. *Leda* (*Saccella*) *subcerata*, n. sp. Holotype (right valve), × 4; (6) exterior and (7) interior of same specimen; U. S. Nat. Mus. No. 352729; page 17. The chondrophore is so small and deeply inset that it is visible only when viewed from below.

FIGS. 8 to 10. *Leda* (*Saccella*) *indigena* Dall. (8) Exterior of cotype (right valve, cotype of *Leda bisulcata* Guppy), × 4; U. S. Nat. Mus. No. 115553; (9) exterior and (10) interior of full-grown left valve × 4; U. S. Nat. Mus. No. 352730; page 17.

FIGS. 11, 12. *Leda* (*Jupiteria*) *bowdenensis bowdenensis* n. sp. and subsp. Holotype (right valve), × 4; (11) exterior and (12) interior of same specimen; U. S. Nat. Mus. No. 352731; page 19.

FIGS. 13, 14. *Leda* (*Jupiteria*) *bowdenensis subtumida*, n. subsp. Holotype (right valve), × 4; (13) exterior and (14) interior of same specimen; U. S. Nat. Mus. No. 352732; page 19.

FIGS. 15, 16. *Leda* (*Jupiteria*) *duerdeni*, n. sp. Holotype (left valve), × 4; (15) exterior and (16) interior of same specimen; U. S. Nat. Mus. No. 352733; page 19.

FIGS. 17 to 19. *Leda* (*Pseudoportlandia*) *clara* Guppy. (17) Exterior of cotype (right valve), × 4; U. S. Nat. Mus. No. 115558; (18) exterior and (19) interior of full-grown left valve, × 4; U. S. Nat. Mus. No. 352734; page 20.

FIGS. 20, 21. *Yoldia* (*Orthoyoldia*) *ovalis* Gabb. (20) Exterior of right and (21) interior of left valves, × 4; U. S. Nat. Mus. No. 135751; page 22.

FIGS. 22, 23. *Tindaria* (*Tindaria*) species. (22) Exterior and (23) interior of left valve, × 10; U. S. Nat. Mus. No. 352735; page 23.

PLATE 2.

FIGS. 1 to 3. *Glycymeris* (*Glycymeris*) *jamaicensis* Dall. (1) Exterior of cotype (right valve), × 1.5; U. S. Nat. Mus. No. 135762; (2) exterior and (3) interior of left valve, × 1.5; U. S. Nat. Mus. No. 352736; page 24.

FIGS. 4, 5. *Glycymeris* (*Glycymeris*) *acuticostata plasia*, n. subsp. Holotype (left valve), × 1.5; (4) exterior and (5) interior of same specimen; U. S. Nat. Mus. No. 352737; page 25.

FIGS. 6, 7. *Glycymeris* (*Glycymerella*) *prepennacea*, n. sp. Holotype (left valve), × 1.5; (6) exterior and (7) interior of same specimen; U. S. Nat. Mus. No. 352738; page 27. Anterior part of hinge defective, due to holes made by a boring animal.

FIGS. 8, 9. *Arca* (*Arca*) *occidentalis* Phillippi. (8) Exterior and (9) interior of left valve, × 1; U. S. Nat. Mus. No. 352739; page 29.

FIGS. 10, 11. *Arca* (*Arca*) *umbonata morantensis*, n. subsp. Holotype (left valve), × 1.5; (10) exterior and (11) interior of same specimen; U. S. Nat. Mus. No. 352740; page 30. In figure 10 the upper part of the shell is tilted a little forward.

PLATE 3.

FIGS. 1 to 4. *Arca* (*Arca*) *bowdeniana* Dall. (1) Exterior and (2) interior of holotype (right valve), × 2; U. S. Nat. Mus. No. 61621; (3) exterior and (4) dorsal views of larger right valve, × 2; U. S. Nat. Mus. No. 352741; page 31.

FIGS. 5, 6. *Arca* (*Arca*) *yaquensis berryi*, n. subsp. Holotype (right valve), × 2; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 352742; page 32.

FIGS. 7, 8. *Barbatia (Barbatia) islopa*, n. sp. Holotype (right valve), × 1.5; (7) exterior and (8) interior of same specimen; U. S. Nat. Mus. No. 352743; page 34.

FIG . 9, 10. *Barbatia (Barbatia) propertua*, n. sp. Holotype (right valve), × 3; (9) exterior and (10) interior of same specimen; U. S. Nat. Mus. No. 352744 page 34.

FIGS. 11, 12. *Barbatia (Barbatia) delepida*, n. sp. Holotype (left valve), × 3; (11) exterior and (12) interior of same specimen; U. S. Nat. Mus. No. 352745; page 34.

FIGS. 13, 14. *Barbatia (Barbatia) endomena*, n. sp. Holotype (right valve), × 2; (13) exterior and (14) interior of same specimen; U. S. Nat. Mus. No. 352746; page 35.

FIGS. 15, 16. *Barbatia (Barbatia) inusitata*, n. sp. Holotype (right valve), × 1.5; (15) exterior and (16) interior of same specimen; U. S. Nat. Mus. No. 352747; page 35.

FIGS. 17, 18. *Barbatia (Acar) domingensis* Lamarck. (17) Exterior and (18) interior of left valve, × 1.5; U. S. Nat. Mus. No. 352748; page 37. The hinge and cardinal area are covered with a calcareous crust.

FIGS. 19, 20. *Barbatia (Obliquarca) dentera*, n. sp. Holotype (left valve), × 1.5; (19) exterior and (20) interior of same specimen; U. S. Nat. Mus. No. 352749; page 39.

FIGS. 21, 22. *Barbatia (Obliquarca) subcandida*, n. sp. Holotype (right valve), × 2; (21) exterior and (22) interior of same specimen; U. S. Nat. Mus. No. 352750; page 39.

FIGS. 23, 24. *Barbatia (Obliquarca) modiolida*, n. sp. Holotype (left valve), × 4; (23) exterior and (24) interior of same specimen; U. S. Nat. Mus. No. 352751; page 40.

PLATE 4.

FIGS. 1, 2. *Arca antiquata* Linné. Holotype (left valve); (1) interior, slightly enlarged, and (2) dorsal, slightly reduced, views of same specimen; Linnean Society of London; locality unknown.

FIGS. 3. 4. *Barbatia (Diluvarca) halidonata halidonata* (Dall). Cotype (left valve), × 1; (3) exterior and (4) interior of same specimen; U. S. Nat. Mus. No. 135756; page 42.

FIGS. 5, 6. *Barbatia (Diluvarca) halidonata oresta*, n. subsp. Holotype (right valve), × 1; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 352752; page 43.

FIG. 7. *Barbatia (Diluvarca) perplura*, n. sp. Holotype (left valve), × 1.5; exterior; U. S. Nat. Mus. No. 352753; page 44.

FIG. 8. *Barbatia (Diluvarca) prephina*, n. sp. Holotype (right valve), × 1.5; exterior; U. S. Nat. Mus. No. 352754; page 44.

PLATE 5.

FIGS. 1 to 3. *Barbatia (Diluvarca) inaequilateralis* (Guppy). (1) Exterior and (2) interior of largest of 5 specimens in Guppy collection labeled "types," (right valve), × 1.5; U. S. Nat. Mus. No. 115679; the actual type material is in the British Museum; (3) exterior of left valve, × 1.5; U. S. Nat. Mus. No. 135763; page 45.

FIG. 4. *Barbatia (Diluvarca) dasia*, n. sp. Holotype (left valve), × 1.5; exterior; U. S. Nat. Mus. No. 352755; page 46.

FIG. 5. *Barbatia (Diluvarca) wordeni*, n. sp. Holotype (left valve), × 1.5; exterior; U. S. Nat. Mus. No. 352756; page 46.

FIG. 6. *Barbatia (Diluvarca) agnastha*, n. sp. Holotype (right valve), × 1.5; exterior; U. S. Nat. Mus. No. 352757; page 47.

FIG. 7. *Barbatia (Diluvarca) thomasensis*, n. sp. Holotype (left valve), × 2; exterior; U. S. Nat. Mus. No. 352758; page 48.

FIGS. 8 to 11. *Barbatia (Diluvarca) donacia* (Dall). (8) Exterior and (9) interior of holotype (left valve), × 4; U. S. Nat. Mus. No. 61628; (10) exterior of larger left and (11) exterior of larger right valves, × 4; U. S. Nat. Mus. No. 352759; page 48.

FIGS. 12, 13. *Barbatia (Diluvarca) microtera*, n. sp. Holotype (left valve), × 4; (12) exterior and (13) interior of same specimen; U. S. Nat. Mus. No. 352760; page 49.

FIGS. 14, 15. *Barbatia (Diluvarca) ophthanta*, n. sp. Holotype (left valve), × 4; (14) exterior and (15) interior of same specimen; U. S. Nat. Mus. No. 352761; page 50.

FIGS. 16, 17. *Fossularca (Fossularca) adamsi sawkinsi*, n. subsp. Holotype (left valve), × 2; (16) exterior and (17) interior of same specimen; U. S. Nat. Mus. No. 352762; page 51.

FIGS. 18 to 21. *Fossularca (Ovalarca) ovalina* (Dall). (18) Exterior and (19) interior of holotype (left valve), × 6; U. S. Nat. Mus. No. 135761; (20) exterior and (21) interior of right valve, × 6; U. S. Nat. Mus. No. 352763; page 52.

PLATE 6.

FIGS. 1 to 3. *Bathyarca hendersoni* (Dall). (1) Exterior of holotype (left valve), × 10; (2) interior of different left valve, × 10; U. S. Nat. Mus. No. 135760; (3) exterior of right valve in attached position, × 10; U. S. Nat. Mus. No. 352764; page 53.

FIGS. 4, 5. *Limopsis (Pectunculina) ovalis silova*, n. subsp. Holotype (left valve), × 4; (4) exterior and (5) interior of same specimen; U. S. Nat. Mus. No. 352765; page 55.

FIGS. 6, 7. *Limopsis (Pectunculina) jamaicensis*, n. sp. Holotype (left valve), × 10; (6) exterior and (7) interior of same specimen; U. S. Nat. Mus. No. 352766; page 55.

FIG. 8. *Pinna refurca*, n. sp. Holotype (broken left valve), × 1.5; exterior; U. S. Nat. Mus. No. 352767; page 56.

FIG. 9. *Atrina* species. Exterior of broken right valve, × 1.5; U. S. Nat. Mus. No. 352768; page 57.

FIG. 10. *Isognomon* species. Interior of broken left valve, × 1.5; U. S. Nat. Mus. No. 352769; page 58.

FIG. 11. *Pteria inornata* (Gabb). Exterior of right valve, × 2; U. S. Nat. Mus. No. 352770; page 58.

FIGS. 12 to 14. *Ostrea (Lopha) paramegodon*, n. sp. (12) Exterior and (13) interior of holotype (right valve), 1.5; U. S. Nat. Mus. No. 352771; (14) exterior of paratype (left valve), × 1.5; U. S. Nat. Mus. No. 352772; page 60.

PLATE 7.

FIGS, 1,2. *Ostrea (Lopha) guppyi*, n. sp. Holotype (right valve), × 1.5; (1) exterior and (2) interior of same specimen; U. S. Nat. Mus. No. 352773; page 61.

FIGS. 3 to 5. *Ostrea (Lopha) folioides*, n. sp. (3) exterior and (4) interior of holotype (right valve), × 1.5; U. S. Nat. Mus. No. 352774; (5) exterior of small left valve having clasping spines, × 1.5; U. S. Nat. Mus. No. 352775; page 61.

FIGS. 6, 7. *Pecten (Pecten) barretti*, n. sp. (6) Exterior of holotype (right valve), × 1; U. S. Nat. Mus. No. 352776; (7) exterior of paratype (left valve of a larger shell), × 1; U. S. Nat. Mus. No. 352777; page 62.

FIGS. 8, 9. *Pecten (Euvola) bowdenensis* Dall. (8) Exterior of cotype (left valve), × 1; U. S. Nat. Mus. No. 135782; (9) exterior of right valve, × 1 U. S. Nat. Mus. No. 352778; page 63.

FIG. 10. *Chlamys (Chlamys)* species. Exterior of right valve (anterior auricle broken), × 6; U. S. Nat. Mus. No. 352779; page 65.

PLATE 8.

FIGS. 1, 2. *Chlamys (Chlamys) vaginulus* (Dall). (1) Exterior of cotype (right valve), × 3; (2) exterior of another cotype (left valve), × 3; U. S. Nat. Mus. No. 135786; page 65.

FIG. 3. *Chlamys (Chlamys) bellipictus*, n. sp. Holotype (right valve), × 6; exterior; U. S. Nat. Mus. No. 352780; page 66.

FIGS. 4, 5. *Chlamys (Aequipecten) plurinominis morantensis*, n. subsp. (4) Exterior of holotype (right valve) × 1; U. S. Nat. Mus. No. 352781; (5) exterior of paratype (left valve), × 1; U. S. Nat. Mus. No. 352782; page 67.

FIGS. 6, 7. *Chlamys (Plagioctenium) uselmae* (Pilsbry and Johnson). (6) Exterior of right and (7) exterior of left valves; × 1; U. S. Nat. Mus. No. 352783; page 69.

FIG. 8. *Chlamys* (*Plagioctenium*) *concinnatus*, n. sp. Holotype (left valve), × 2; exterior; U. S. Nat. Mus. No. 352784; page 70.

FIG. 9. *Chlamys* (*Plagioctenium*) *ameleus*, n. sp. Holotype (right valve), × 2; exterior; U. S. Nat. Mus. No. 352785; page 70.

FIG. 10. *Chlamys* (*Plagioctenium*) *mansfieldi*, n. sp. Holotype (left valve), × 4; exterior; U. S. Nat. Mus. No. 352786; page 71.

FIGS. 11, 12. *Chlamys* (*Plagioctenium*) *gonioides*, n. sp. (11) Exterior of holotype (left valve), × 2; U. S. Nat. Mus. No. 352787; (12) exterior of paratype (right valve), × 2; U. S. Nat. Mus. No. 353076; page 71.

FIGS. 13 to 16. *Chlamys* (*Palliolum?*) *guppyi* (Dall). (13) Exterior and (14) interior of cotype (left valve), × 8; (15) exterior and (16) interior of another cotype (right valve), × 8; U. S. Nat. Mus. No. 135779; page 72.

PLATE 9.

FIGS. 1, 2. *Amusium* (*Amusium*) *papyraceum* Gabb? (1) Exterior and (2) interior of small piece of a large valve, × 1; U. S. Nat. Mus. No. 135780; page 73.

FIGS. 3, 4. *Amusium* (*Parvamussium*) *spendulum*, n. sp. Holotype (left valve), × 6; (3) exterior and (4) interior of same specimen; U. S. Nat. Mus. No. 352788; page 75.

FIGS. 5 to 7. *Spondylus bostrychites* Guppy. (5) Exterior and (6) interior of right valve, × 1; U. S. Nat. Mus. No. 115522. (7) exterior of smaller right valve having wide primary ribs, × 1.5; U. S. Nat. Mus. No. 352789; page 76.

FIG. 8. *Spondylus* species. Exterior of left valve, × 3; U. S. Nat. Mus. No. 352790; page 77.

FIGS. 9 to 11. *Plicatula guppyi*, n. sp. (9) Exterior and (10) interior of holotype (right valve, a cotype of *Plicatula vexillata* Guppy), × 2; U. S. Nat. Mus. No. 115536; (11) exterior of left valve, × 2; U. S. Nat. Mus. No. 352791; page 78.

FIGS. 12, 13. *Lima* (*Lima*) *stenacostata*, n. sp. Holotype (left valve), × 4; (12) exterior and (13) interior of same specimen; U. S. Nat. Mus. No. 352792; page 79.

FIGS. 14, 15. *Lima* (*Mantellum*) species. (14) Exterior and (15) interior of broken right valve, × 4; U. S. Nat. Mus. No. 352793; page 80.

PLATE 10.

FIGS. 1, 2. *Limea solida* Dall. Holotype (left valve), × 8. (1) Exterior and (2) interior of same specimen; U. S. Nat. Mus. No. 135679; page 81.

FIGS. 3 to 5. *Placunanomia lithobleta* Dall. (3) Exterior and (4) interior of cotype (broken right valve), × 1; (5) interior of another cotype (broken left valve), × 1; U. S. Nat. Mus. No. 135778; page 82.

FIGS. 6 to 9. *Anomia indecisa* Dall. (6) Exterior and (7) interior of same specimen (large left valve), × 2; U. S. Nat. Mus. No. 352794; (8) interior of a broken left valve and (9) interior of small left valve, × 2; U. S. Nat. Mus. No. 135777; page 84.

FIGS. 10 to 12. *Modiolus* (*Brachydontes*) *guppyi* Dall. (10) Exterior of cotype (left valve), × 4; (11) exterior of another cotype (small right valve), × 4; U. S. Nat. Mus. No. 135747; (12) interior of right valve, × 4; U. S. Nat. Mus. No. 353073; page 85.

FIGS. 13, 14. *Mytilopsis jamaicensis*, n. sp. Holotype (left valve), × 2; (13) exterior and (14) interior of same specimen; U. S. Nat. Mus. No. 352795; page 86.

FIGS. 15, 16. *Julia gardnerae*, n. sp. Holotype (left valve), × 3; (15) exterior and (16) interior of same specimen; U. S. Nat. Mus. No. 352796; page 88.

FIGS. 17 to 19. *Poromya jamaicensis* Dall. (17) Exterior of holotype (left valve), × 4; (18) interior of different left valve and (19) interior of right valve, × 4; U. S. Nat. Mus. No. 135690; page 88.

FIGS. 20 to 22. *Cuspidaria* (*Cardiomya*) *craspedonia* Dall. 3 cotypes, × 6; (20) and (21) exteriors and (22) interior of 3 different left valves; U. S. Nat. Mus. No. 135691; page 90.

PLATE 11.

FIGS. 1 to 5. *Cuspidaria* (*Bowdenia*) *distira* Dall. (1) Exterior of cotype (left valve), × 6; (2) exterior and (3) interior of different left valve, × 6; (4) exterior and (5) interior of right valve, × 6; U. S. Nat. Mus. 135692; page 91.

FIGS. 6 to 8. *Verticordia* (*Trigonulina*) *bowdenensis* Dall. 3 cotypes, × 6; (6) exterior of left valve; (7) interior of a different left valve; (8) interior of right valve; U. S. Nat. Mus. No. 135689; page 92.

FIGS. 9 to 11. *Verticordia* (*Haliris*) *jamaicensis* Dall. 3 cotypes, × 6; (9) exterior of right valve; (10) interior of different right valve; (11) interior of left valve; U. S. Nat. Mus. No. 135688; page 93.

FIGS. 12 to 15. *Crassatellites* (*Crassatellites*) *jamaicensis* Dall. 2 cotypes, × 1; (12) exterior and (13) interior of left valve; (14) exterior and (15) interior of smaller right valve; U. S. Nat. Mus. No. 135683; page 94.

FIGS. 16, 17. *Crassatellites* (*Crassatellites*) *altaspissus*, n. sp. Holotype (right valve), × 1; (16) exterior and (17) interior of same specimen; U. S. Nat. Mus. No. 352797; page 95.

FIGS. 18 to 20. *Crassinella guppyi* Dall. (18) Exterior of holotype (right valve), × 6; U. S. Nat. Mus. No. 107151; (19) interior of different right valve, × 6; (20) interior of left valve, × 6; U. S. Nat. Mus. No. 135684; page 96.

PLATE 12.

FIGS. 1 to 4. *Crassinella bowdenensis* Dall. (1) Exterior of cotype (right valve), × 6: (2 right valve of another cotype (both valves in attached position), × 6; (3) interior of right and (4) interior of left valve, × 6; U. S. Nat. Mus. 135685; page 97. In figure 2 the shell is tilted to the right.

FIGS. 5, 6. *Crassinella xena*, n. sp. Holotype (left valve), × 10; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 352798; page 98.

FIGS. 7 to 9. *Cardita* (*Glans*) *scabricostata* Guppy. (7) Exterior of left valve, largest of 17 specimens in Guppy collection labeled "types," × 2; U. S. Nat. Mus. No. 115669; (8) interior of another left valve and (9) interior of right valve, × 2; U. S. Nat. Mus. No. 135676; page 99. The actual type is in the British Museum.

FIGS. 10 to 12. *Venericardia* (*Pleuromeris*) *acaris* Dall. 3 cotypes, × 6; (10) exterior of left valve; (11) interior of different left valve; (12) interior of right valve; U. S. Nat. Mus. No. 135677; page 102.

FIGS. 13 to 17. *Chama involuta* Guppy. (13) Exterior and (14) interior of left valve, × 2; (15) exterior and (16) interior of right valve, × 2; U. S. Nat. Mus. No. 352799; (17) exterior of left valve showing nepionic shell, × 6; U. S. Nat. Mus. No. 352800; page 103.

FIGS. 18, 19. *Chama macerophylla* Gmelin. (18) Exterior and (19) interior of right valve, × 1.5; U. S. Nat. Mus. No. 352801; page 104.

PLATE 13.

FIGS. 1 to 4. *Echinochama antiquata* Dall. (1) Exterior and (2) interior of cotype (left valve), × 1; U. S. Nat. Mus. No. 135740; (3) exterior and (4) interior of right valve, × 1 U. S. Nat. Mus. No. 352802; page 106.

FIGS. 5, 6. *Codąkia* (*Codakia*) *spinulosa* Dall. Holotype (right valve), × 2; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 135713; page 108

FIGS. 7, 8. *Codakia* (*Codakia*) *lomonea*, n. sp. Holotype (right valve), × 2; (7) exterior and (8) interior of same specimen; U. S. Nat. Mus. No. 352803; page 108.

PLATE 14.

FIGS. 1 to 4. *Codakia* (*Jagonia*) *vendryesi* Dall. (1) Exterior of cotype (right valve), × 4; (2) exterior of another cotype (left valve), × 4; (3) interior of larger right and (4) left valves, × 4; U. S. Nat. Mus. No. 135720; page 109.

FIGS. 5 to 7. *Codakia* (*Jagonia*) *guppyi*, n. name. (5) Exterior of cotype (right valve, a cotype of *Lucina textilis* Guppy), × 2; U. S. Nat. Mus. No. 107103; (6) interior of larger right valve, × 2; U. S. Nat. Mus. No. 352804; (7) interior of left valve, × 2; U. S. Nat. Mus. No. 135718; page 110.

FIGS. 8, 9. *Lucina* (*Lucina*) *bowdenensis*, n. sp. Holotype (left valve), × 1.5; (8) exterior and (9) interior of same specimen; U. S. Nat. Mus. No. 352805; page 111.

FIGS. 10 to 12. *Myrtaea* (*Myrtaea*) *limoniana* Dall. (10) Exterior and (11) interior of holotype (right valve), × 2; (12) interior of smaller left valve, × 2; U. S. Nat. Mus. No. 157637; page 112.

FIGS. 13 to 16. *Myrtaea* (*Myrtaeopsis*) *pertenera* (Dall). (13) Exterior and (14) interior of cotype (left valve), × 1.5; U. S. Nat. Mus. No. 135716; (15) exterior and(16) interior of smaller right valve, × 1.5; U. S. Nat. Mus. No. 352806; page 113.

PLATE 15.

FIGS. 1 to 3. *Myrtaea* (*Eulopia*) *vermiculata* Dall. (1) Exterior and (2) interior of holotype (right valve), × 4; (3) interior of left valve, × 4; U. S. Nat. Mus. No. 135717; page 114.

FIGS. 4, 5. *Myrtaea* (*Eulopia*) *furcata Dall.* Cotype (right valve), × 2; (4) exterior and (5) interior of same specimen; U. S. Nat. Mus. No. 135714; page 115.

FIG. 6. *Miltha* (*Megaxinus*) *gluminda*, n. sp. Holotype, × 1.5; exterior; U. S. Nat. Mus. No. 352807; page 117.

FIG. 7. *Phacoides* (*Phacoides?*) species. Exterior of broken right valve, × 1.5; U. S. Nat. Mus. No. 135712; page 117.

FIGS. 8 to 11. *Phacoides* (*Linga*) *podagrinus podagrinus* Dall. (8) Exterior and (9) interior of cotype (right valve), × 1.5; (10) exterior of a greatly inflated right valve, × 1.5; U. S. Nat. Mus. No. 135710; (11) interior of small left valve, × 1.5; U. S. Nat. Mus. No. 135711; page 119.

FIG. 12. *Phacoides* (*Linga*) *podagrinus alarantus*, n. subsp. Holotype (right valve), × 1; exterior; U. S. Nat. Mus. No. 352808; page 119.

PLATE 16.

FIG. 1. *Phacoides* (*Linga*) *browni*, n. sp. Holotype (left valve), × 1; exterior; U. S. Nat. Mus. No. 352809; page 120.

FIGS. 2, 3. *Phacoides* (*Linga*) *tithonis* Dall. Holotype (right valve), × 6; (2) exterior and (3) interior of same specimen; U. S. Nat. Mus. No. 135723; page 120.

FIGS. 4 to 6. *Phacoides* (*Pleurolucina*) *quadricostatus* Dall. Holotype (left valve), × 6; (4) exterior, (5) interior, and (6) lateral views of same specimen; U. S. Nat. Mus. No. 135722; page 121.

FIGS. 7, 8. *Phacoides* (*Cardiolucina*) *recurrens* Dall. Holotype (right valve), × 4; (7) exterior and (8) interior of same specimen; U. S. Nat. Mus. No. 135721; page 122.

FIGS. 9 to 13. *Phacoides* (*Callucina*) *pauperatus pauperatus* Guppy. (9) Exterior and (10) interior of cotype (small left valve), × 2; U. S. Nat. Mus. No. 107101; (11) exterior and (12) interior of larger left, and (13) interior of right valves, × 2; U. S. Nat. Mus. No. 135715; page 123.

FIGS. 14, 15. *Phacoides* (*Callucina*) *pauperatus oligocostatus*, n. subsp. Holotype (right valve), × 2; (14) exterior and (15) interior of same specimen; U. S. Nat. Mus. No. 352810; page 124.

FIGS. 16, 17. *Phacoides* (*Callucina*) *eurycostatus*, n. sp. Holotype (left valve), × 4; (16) exterior and (17) interior of same specimen; U. S. Nat. Mus. No. 352811; page 124.

PLATE 17.

FIGS. 1, 2. *Phacoides* (*Parvilucina*) *yaquensis morantensis*, n. subsp. Holotype (right valve), × 6; (1) exterior and (2) interior of same specimen; U. S. Nat. Mus. No. 352812; page 125.

FIGS. 3, 4. *Phacoides* (*Parvilucina*) *limnidus*, n. sp. Holotype (right valve), × 6; (3) exterior and (4) interior of same specimen; U. S. Nat. Mus. No. 352813; page 126.

FIGS. 5 to 8. *Phacoides* (*Bellucina*) *actinus* Dall. 4 cotypes, × 6; (5) exterior of right valve; (6) interior of different right valve; (7) exterior of left valve; (8) interior of different left valve; U. S. Nat. Mus. No. 135719; page 126.

FIGS. 9 to 13. *Divaricella* (*Divaricella*) *prevaricata* (Guppy). (9) Exterior and (10) interior of holotype (small left valve), × 2; (11) interior of larger right valve, × 2; U. S. Nat.Mus. No. 107102; (12) exterior and (13) interior of larger left valve, × 2; U. S. Nat.Mus. No. 352814; page 128.

FIGS. 14, 15. *Diplodonta* (*Diplodonta*) *walli*, n. sp. Holotype (right valve), × 6; (14) exterior and (15) interior of same specimen; U. S. Nat. Mus. No. 352815; page 129.

FIGS. 16, 17. *Diplodonta* (*Diplodonta*) *homalostriata*, n. sp. Holotype (right valve), × 6; (16) exterior and (17) interior of same specimen; U. S. Nat. Mus. No. 352816; page 129.

FIGS. 18 to 21. *Diplodonta* (*Felaniella*) *minor* Dall. (18) Exterior and (19) interior of holotype (left valve), × 6; (20) exterior and (21) interior of right valve, × 6; U. S. Nat. Mus. No. 135724; page 130.

PLATE 18.

FIGS. 1 to 3. *Diplodonta* (*Phlyctiderma*) *gabbi* Dall. (1) Exterior and (2) interior of right valve (cotype of *D. puncturella* Dall), × 6; (3) exterior of left valve (another cotype of *D. puncturella* Dall), × 6; U. S. Nat. Mus. No. 155744; page 131.

FIGS. 4, 5. *Erycina* (*Erycina*) *olssoni*, n. sp. Holotype (right valve, a specimen in Henderson collection labeled *Erycina quadrata* Gabb), × 6; (4) exterior and (5) interior of same specimen; U. S. Nat. Mus. No. 135687; page 132.

FIGS. 6, 7. *Erycina* (*Erycina*) *pura* n. sp. Holotype (right valve), × 6; (6) exterior and (7) interior of same specimen; U. S. Nat. Mus. No. 352817; page 133.

FIGS. 8, 9. *Neaeromya menotreta*, n. sp. Holotype (left valve), × 6; (8) exterior and (9) interior of same specimen; U. S. Nat. Mus. No. 352818; page 133.

FIGS. 10, 11. *Cardium* (*Acanthocardia?*) *dissidepictum*, n. sp. Holotype (left valve), × 1.5; (10) exterior and (11) interior of same specimen; U. S. Nat. Mus. No. 352819; page 135. The anterior cardinal of this specimen is broken off.

FIGS. 12, 13. *Cardium* (*Trachycardium*) *lingualeonis* Guppy. (12) Exterior and (13) interior of right valve, × 1; U. S. Nat. Mus. No. 352820; page 136.

FIGS. 14 to 16. *Cardium* (*Trachycardium*) *bowdenense* Dall. (14) Exterior of small left valve (probably cotype, but not so labeled, 1 of 2 specimens in Guppy collection originally labeled *C. muricatum* Linné), × 2; U. S. Nat. Mus. No. 115667; (15) exterior and (16) interior of larger right valve, × 2 U. S. Nat. Mus. No. 352821; page 137.

PLATE 19.

FIGS. 1, 2. *Cardium* (*Trachycardium*) *inconspicuum* Guppy. (1) Exterior and (2) interior of right valve, × 1; U. S. Nat. Mus. No. 135730; page 138.

FIGS. 3, 4. *Cardium* (*Trachycardium*) *waylandi*, n. sp. Holotype (right valve), × 1; (3) exterior and (4) interior of same specimen; U. S. Nat. Mus. No. 352822; page 139.

FIGS. 5, 6. *Cardium* (*Fragum*) *medium* Linné. (5) Exterior and (6) interior of right valve, × 1; U. S. Nat. Mus. No. 352823; page 140.

FIG. 7. *Cardium* (*Fragum*) *elattocostatum*, n. sp. Holotype (right valve), × 4; exterior; U. S. Nat. Mus. No. 352824; page 141.

FIGS. 8, 9. *Cardium* (*Trigoniocardia*) *haitense haitense* Sowerby. (8) Exterior and (9) interior of left valve, × 1.5; U. S. Nat. Mus. No. 352825; page 142.

FIGS. 10, 11. *Cardium* (*Trigoniocardia*) *haitense cercadicum* Maury. (10) Exterior and (11) interior of left valve, × 1.5; U. S. Nat. Mus. No. 352826; page 143. In figure 10 the shell is tilted to the left.

FIGS. 12, 13. *Cardium* (*Trigoniocardia*) *thaumastum*, n. sp. Holotype (right valve), × 2; (12) exterior and (13) interior of same specimen; U. S. Nat. Mus. No. 352827; page 144.

FIGS. 14–16. *Cardium* (*Laevicardium*) *serratum* Linné. (14) Exterior of broken left valve, × 1; U. S. Nat. Mus. No. 135728; (15) exterior and (16) interior of smaller left valve, × 1; U. S. Nat. Mus. No. 352828; page 145.

FIG. 17. *Protocardia* (*Nemocardium*) *jamaicensis* Dall. Holotype (left valve), × 4; exterior; U. S. Nat. Mus. No. 135733; page 147.

PLATE 20.

FIGS. 1–5. *Pliocardia bowdeniana* (Dall). (1) Exterior of holotype (small right valve), × 4; U. S. Nat. Mus. No. 135671; (2) exterior and (3) interior of full-grown right valve, × 4; (4) exterior and (5) interior of full-grown left valve, × 4; U. S. Nat. Mus. No. 352829; page 148.

FIGS. 6, 7. *Tivela* (*Tivela*) *jamaicensis* Dall. Holotype (left valve), × 4; (6) exterior and (7) interior of same specimen; U. S. Nat. Mus. No. 135675; page 149.

FIGS. 8–10. *Gafrarium* (*Gouldia*) *insulare* Dall and Simpson. (8) Exterior and (9) interior of right valve, and (10) interior of left valve, × 4; U. S. Nat. Mus. No. 135674; page 150.

FIGS. 11, 12. *Callocardia* (*Callocardia*) *ammondea*, n. sp. Holotype (left valve), × 4; (11) exterior and (12) interior of same specimen; U. S. Nat. Mus. No. 352830; page 151.

FIGS. 13, 14. *Callocardia* (*Callocardia*) *elethusa*, n. sp. Holotype (left valve), × 4; (13) exterior and (14) interior of same specimen; U. S. Nat. Mus. No. 352831; page 152.

FIGS. 15 to 19. *Pitar* (*Hyphantosoma*) *carbaseus* (Guppy). (15) Exterior and (16) interior of broken right valve, × 1; (17) exterior and (18) interior of broken left valve, × 1; (these 2 specimens from the Guppy collection are labeled. "types," though the actual type is in the British Museum); U. S. Nat. Mus. No. 115552; (19) exterior of right valve, × 1; U. S. Nat. Mus. No. No. 352832; page 153.

PLATE 21.

FIGS. 1 to 4. *Pitar* (*Hysteroconcha*) *planivietus* (Guppy). (1) Exterior of right and (2) exterior of left valve, × 1; (these 2 specimens from the Guppy collection are labeled "types," though the actual type is in the British Museum); U. S. Nat. Mus. No. 115550; (3) interior of another right valve, × 1; U. S. Nat. Mus. No. 135665; (4) interior of small left valve, × 1; U. S Nat. Mus. No. 115551; page 155.

FIGS. 5 to 9. *Antigona* (*Ventricola*) *blandiana* (Guppy). (5) Exterior and (6) interior of holotype (right valve), × 1; Dominican Republic (original label reads "Haiti"); U. S. Nat. Mus. No. 115548; (7) exterior of right valve, × 1; U. S. Nat. Mus. No. 352833; (8) exterior and (9) interior of small right valve, × 1; (1 of 3 specimens in Guppy collection also labeled "types"); U. S. Nat. Mus. No. 115547; page 157.

FIGS. 10, 11. *Cyclinella plasiatenuis*, n. sp. Holotype (left valve), × 1.5; (10) exterior and (11) interior of same specimen; U. S. Nat. Mus. No. 352834; page 158.

FIGS. 12 to 14. *Chione* (*Chione*) *sawkinsi*, n. sp. (12) Exterior of right valve (1 of 7 specimens in Guppy collection labeled "types" of *Venus woodwardi*, though the actual type is in the British Museum), × 1.5; U. S. Nat. Mus. No. 115545; (13) exterior and (14) interior of holotype (different right valve), × 1.5; U. S. Nat. Mus. No. 352836; page 159.

PLATE 22.

FIGS. 1 to 4. *Chione* (*Chione*) *woodwardi* (Guppy). (1) Exterior and (2) interior of left valve, × 1.5; U. S. Nat. Mus. No. 352836; (3) exterior and (4) interior of right valve, × 1.5; U. S. Nat. Mus. No. 135667; page 160.

FIGS. 5, 6. *Chione* (*Chione*) *retugida*, n. sp. Holotype (left valve), × 4; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 352837; page 161.

FIGS. 7 to 10. *Chione* (*Lirophora*) *hendersoni* Dall. (7) Exterior and (8) interior of cotype (right valve), × 1.5; U. S. Nat. Mus. No. 115543; (9) interior of left valve, × 1.5; U. S. Nat. Mus. No. 115542; (10) exterior of large left valve, × 1.5; U. S. Nat. Mus. No. 352838; page 163. In figure 8 the anterior cardinal is broken.

FIGS. 11, 12. *Parastarte antillensis*, n. sp. Holotype, (left valve), × 8; (11) exterior and (12) interior of same specimen; U. S. Nat. Mus. No. 352839; page 164.

FIGS. 13 to 15. *Cooperella* (*Cooperellopsis*) *thaumasta*, n. sp. Holotype (left valve), × 4; (13) exterior, (14) interior, and (15) dorsal views of same specimen; U. S. Nat. Mus. No. 352840; page 165. In figure 13 the shell is tilted to the left.

PLATE 23.

FIGS. 1 to 3. *Tellina* (*Moerella*) *simpsoni* Dall. (1) Exterior of holotype (right valve), × 4; U. S. Nat. Mus. No. 135697; (2) interior of different right valve, × 4; U. S. Nat. Mus. No. 352841; (3) interior of small left valve, × 4; U. S. Nat. Mus. No. 135697; page 167. In figure 3 the hinge is defective.

FIGS. 4 to 7. *Tellina* (*Moerella*) *hendersoni* Dall. (4) Exterior of holotype (left valve), × 4; U. S. Nat. Mus. No. 135696; (5) interior of different left valve, × 4; U. S. Nat. Mus. No. 352842; (6) exterior and (7) interior of right valve, × 4; U. S. Nat. Mus. No. 135696; page 167.

FIGS. 8, 9. *Tellina* (*Eurytellina*) species. (8) Exterior and (9) interior of right valve, × 4; U. S. Nat. Mus. No. 135703; page 168.

FIGS. 10, 11. *Tellina* (*Eurytellina*) *spiekeri*, n. sp. Holotype (right valve), × 4; (10) exterior and (11) interior of same specimen; U. S. Nat. Mus. No. 352843; page 168.

FIGS. 12 to 15. *Tellina* (*Eurytellina*) *pharcida* Dall. (12) Exterior of holotype (right valve), × 4; (13) interior of another right valve, × 4; U. S. Nat. Mus. No. 135706; (14) exterior and (15) interior of left valve, × 4; U. S. Nat. Mus. No. 353074; page 169.

FIGS. 16, 17. *Tellina* (*Eurytellina*) *gonida*, n. sp. Holotype (left valve), × 6; (16) exterior and (17) interior of same specimen; U. S. Nat. Mus. No. 352844; page 169.

FIG. 18. *Tellina* (*Eurytellina*) *halistrepta* Dall. Holotype (right valve), × 2; exterior; U. S. Nat. Mus. No. 135704; page 169.

FIGS. 19, 20. *Tellina* (*Eurytellina*) *apomsa*, n. sp. Holotype (right valve), × 6; (19) exterior and (20) interior of same specimen; U. S. Nat. Mus. No. 352845; page 170.

FIGS. 21, 22. *Tellina* (*Eurytellina*) *browni*, n. sp. Holotype (right valve), × 4; (21) exterior and (22) interior of same specimen; U. S. Nat. Mus. No. 352846; page 170.

PLATE 24.

FIGS. 1 to 4. *Tellina* (*Merisca*) *sclera sclera* Dall. (1) Exterior of holotype (right valve), × 4; (2) interior of left valve, × 4; U. S. Nat. Mus. No. 135698; (3) exterior and (4) interior of right valve, × 4; U. S. Nat. Mus. No. 352847; page 171.

FIGS. 5, 6. *Tellina* (*Merisca*) *sclera lerasca*, n. subsp. Holotype (left valve), × 4; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 352848; page 172.

FIGS. 7 to 10. *Tellina* (*Merisca*) *acrocosmia* Dall. (7) Exterior and (8) interior of holotype (right valve), × 4; (9) exterior and (10) interior of left valve, × 4; U. S. Nat. Mus. No. 135699; page 172.

FIGS. 11 to 13. *Tellina* (*Scissula*) *healyi*, n. name. (11) Exterior of holotype (left valve), × 4; U. S. Nat. Mus. No. 135707; (12) exterior and (13) interior of right valve, × 4; U. S. Nat. Mus. No. 352849; page 173.

FIGS. 14 to 16. *Tellina* (*Elliptotellina*) *cymobia*, n. sp. (14) Exterior and (15) interior of holotype (left valve), × 4; U. S. Nat. Mus. No. 352850; (16) interior of right valve, × 4; U. S. Nat. Mus. No. 353075; page 174.

FIGS. 17, 18. *Strigilla* (*Strigilla*) *pisiformis* Linné. (17) Exterior and (18) interior of right valve, × 4; U. S. Nat. Mus. No. 352851; page 175.

FIG. 19. *Macoma* (*Psammocoma*) *tracta* Dall. Holotype (right valve), × 4; exterior; U. S. Nat. Mus. No. 135702; page 176.

FIGS. 20, 21. *Macoma* (*Psammacoma*) *olivella* Dall. Holotype (left valve), × 2; (20) exterior and (21) interior of same specimen; U. S. Nat. Mus. No. 135708; page 177.

FIGS. 22 to 24. *Macoma* (*Cymatoica*) *vendryesi* Dall. (22) Exterior of cotype (left valve), × 4; U. S. Nat. Mus. No. 135695; (23) exterior and (24) interior of larger right valve, × 4; U. S. Nat. Mus. No. 352852; page 178.

PLATE 25.

FIGS. 1, 2. *Semele* (*Semele*) *calliconcinnata*, n. sp. Holotype (left valve), × 4; (1) exterior and (2) interior of same specimen; U. S. Nat. Mus. No. 352853; page 178.

FIGS. 3, 4. *Abra* (*Abra*) *triangulata* Dall. (3) exterior and (4) interior of left valve, × 4; U. S. Nat. Mus. No. 352854; page 179.

FIGS. 5, 6. *Abra* (*Abra*) *deutera*, n. sp. Holotype (right valve), × 8; (5) exterior and (6) interior of same specimen; U. S. Nat. Mus. No. 352855; page 180.

FIGS. 7, 8. *Donax* (*Donax*) species. (7) Exterior and (8) interior of right valve, × 4; U. S. Nat. Mus. No. 135693; page 181.

FIGS. 9, 10. *Donax* (*Paradonax*) *lennoxi*, n. sp. Holotype (left valve), × 4; (9) exterior and (10) interior of same specimen; U. S. Nat. Mus. No. 135693; page 182.

FIGS. 11 to 14. *Psammosolen sancti-dominici* Maury. (11) Exterior and (12) interior of left valve, × 1; U. S. Nat. Mus. No. 352856; (13) exterior and (14) interior of larger right valve (specimen in Henderson collection labeled "*Macha vicksburgensis* Ald.?") × 1; U. S. Nat. Mus. No. 135681; page 182. In figures 12 and 14 the hinge is defective.

FIGS. 15, 16. *Spisula* (*Mactromeris*) *matleyi*, n. sp. Holotype (right valve), × 1.5; (15) exterior and (16) interior of same specimen; U. S. Nat. Mus. No. 352857; page 184.

FIGS. 17, 18. *Ervilia gabbi*, n. sp. Holotype (left valve), × 6; (17) exterior and (18) interior of same specimen; U. S. Nat. Mus. No. 352858; page 185.

FIGS. 19 to 22. *Corbula* (*Corbula*) *sericea* Dall. (19) Exterior and (20) interior of right valve, × 4; (21) exterior and (22) interior of left valve, × 4; U. S. Nat. Mus. No. 352859; page 186.

PLATE 26.

FIGS. 1 to 4. *Corbula* (*Corbula*) *heterogena* Dall. (1) Exterior and (2) interior of holotype (right valve), × 2; U. S. Nat. Mus. No. 107099; (3) exterior and (4) interior of left valve, × 2; U. S. Nat. Mus. No. 352860; page 187.

FIGS. 5 to 8. *Corbula* (*Bothrocobula*) *viminea* Guppy. (5) Exterior and (6) interior of right valve, × 2; (7) exterior and (8) interior of left valve, × 2; (2 of 5 specimens in Guppy collection labeled "types," though the actual type is in the British Museum); U. S. Nat. Mus. No. 115648; page 189.

FIGS. 9, 10. *Basterotia* (*Basterotia*) *bowdeniana* Dall. Holotype (right valve), × 2; (9) exterior and (10) interior of same specimen; U. S. Nat. Mus. No. 135749; page 191.

FIGS. 11, 12. *Gastrochaena* (*Gastrochaena*) *rotunda* Dall. (11) Exterior and (12) interior of left valve, × 2; U. S. Nat. Mus. No. 352861; page 192.

FIGS. 13 to 15. *Jouannetia sphaeroidalis* (Guppy). Holotype (both valves originally in attached position), × 4; (13) right valve, (14) anterior end, and (15) posterior end of same specimen; U. S. Nat. Mus. No. 107100; page 193.

FIGS. 16, 17. *Martesia bowdeniana* (Dall). Holotype (anterior part of left valve), × 4; (16) exterior and (17) interior of same specimen; U. S. Nat. Mus. No. 135737; page 194.

FIG. 18. *Xylophaga?* species. Exterior of imperfect left valve, × 4; U. S. Nat. Mus. No. 135738; page 195.

PLATE 27.

FIGS. 1, 2. *Dentalium* (*Dentalium*) *cossmannianum* Pilsbry and Sharp. (1) Lateral view and (2) section of anterior end of broken specimen, × 4; U. S. Nat. Mus. No. 352713; page 197.

FIGS. 3, 4. *Dentalium* (*Dentalium*) *glaucoterrarum* Maury. (3) Lateral view and (4) section of anterior end of broken specimen, × 4; U. S. Nat. Mus. No. 352714; page 198.

FIGS. 5, 6. *Dentalium* (*Dentalium?*) species *a*. (5) Lateral view and (6) section of anterior end of broken specimen, × 6; U. S. Nat. Mus. No. 352715; page 198.

FIGS. 7, 8. *Dentalium* (*Dentalium?*) species *b*. (7) Lateral view, × 6; and (8) section of anterior end of broken specimen, × 12; U. S. Nat. Mus. No. 352716; page 199.

FIGS. 9 to 14. *Dentalium* (*Tesseracme*) *dissimile dissimile* Guppy. (9) Lateral view, (10) section of posterior end, and (11) section of anterior end of specimen with broken apex, × 2; U. S. Nat. Mus. No. 352717; (12) lateral view, (13) section of anterior end, and (14) section of posterior end of large specimen with sculptured posterior part broken off, × 2; U. S. Nat. Mus. No. 352718; page 199.

FIGS. 15 to 17. *Dentalium* (*Tesseracme*) *dissimile ponderosum* Gabb. (15) Lateral view, (16) section of posterior end, and (17) section of anterior end of specimen broken at both ends, × 2; U. S. Nat. Mus. No. 352719; page 200.

FIGS. 18 to 20. *Dentalium* (*Laevidentalium*) *haytense* Gabb. (18) Lateral view of large specimen broken at both ends, × 4; (19) lateral view and (20) section of anterior end of small specimen broken at both ends, × 4; U. S. Nat. Mus. No. 352720; page 202.

FIGS. 21 to 23. *Dentalium* (*Episiphon*) *schumoi* Pilsbry. (21) Lateral view and (22) section of anterior end, × 6; (23) apical detail of same specimen, × 12; U. S. Nat. Mus. No. 352721; page 203.

FIGS. 24, 25. *Dentalium* (*Episiphon*) *macilentum* Pilsbry. (24) Lateral view and (25) section of anterior end of same specimen, × 6; U. S. Nat. Mus. No. 352722; page 204.

PLATE 28.

FIG. 1. *Cadulus* (*Cadulus*) *simrothi* Pilsbry. Dorsal view, × 10; U. S. Nat. Mus. No. 352723; page 205.

FIGS. 2, 3. *Cadulus* (*Gadilopsis*) *dentalinus* (Guppy). Cotype; (2) lateral view, × 4; (3) lateral view of apical part, × 8; U. S. Nat. Mus. No. 115607; page 206.

FIG. 4. *Cadulus* (*Gadilopsis*) *hendersoni*, n. sp. Holotype, × 4; lateral view; U. S. Nat. Mus. No. 352724; page 207.

FIGS. 5, 6. *Cadulus* (*Polyschides*) *annulatus* Pilsbry. (5) Lateral view, × 4; (6) detail of sculpture, × 8; U. S. Nat. Mus. No. 135528; page 207.

FIGS. 7 to 9. *Cadulus* (*Platyschides*) *depressicolis* Pilsbry and Sharp. (7) Lateral, (8) dorsal, and (9) ventral views of specimen broken at posterior end, × 4; U. S. Nat. Mus. No. 352725; page 209.

FIG. 10. *Cadulus* (*Platyschides*) *pilsbryi*, n. sp. Holotype, × 4; lateral view; U. S. Nat. Mus. No. 352726; page 209.

FIG. 11. *Cadulus* (*Platyschides*) *annectens*, n. sp. Holotype, × 8; lateral view; U. S. Nat. Mus. No. 353077; page 210.

FIG. 12. *Cadulus* (*Platyschides*) *arrosus*, n. sp. Holotype, × 8; lateral view; U. S. Nat. Mus. No. 353078; page 210.

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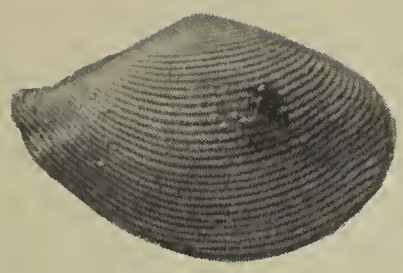

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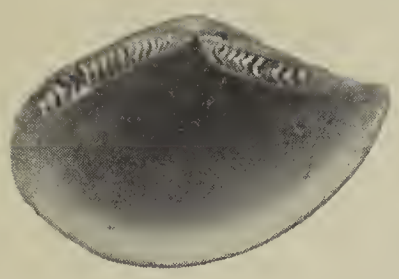

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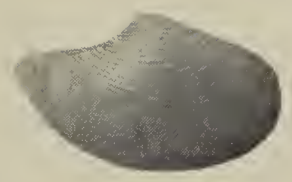

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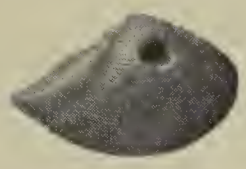

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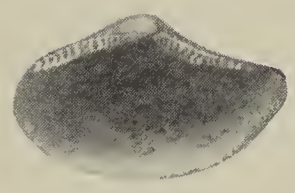

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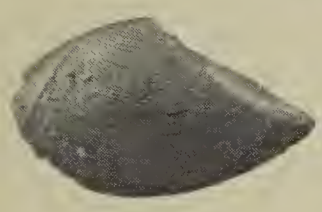

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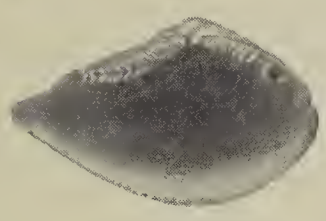

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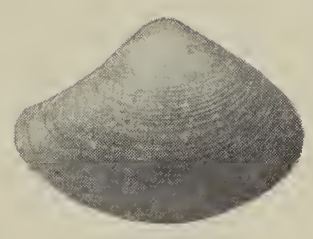

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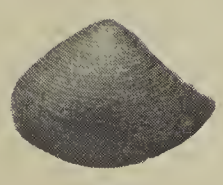

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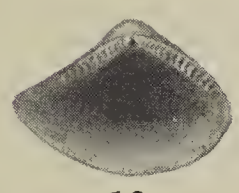

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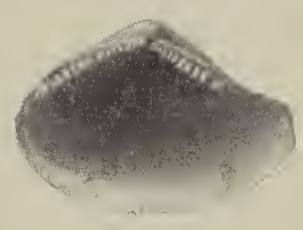

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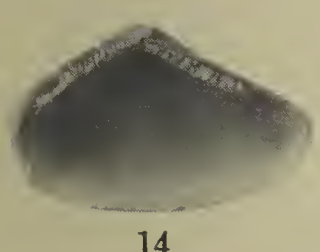

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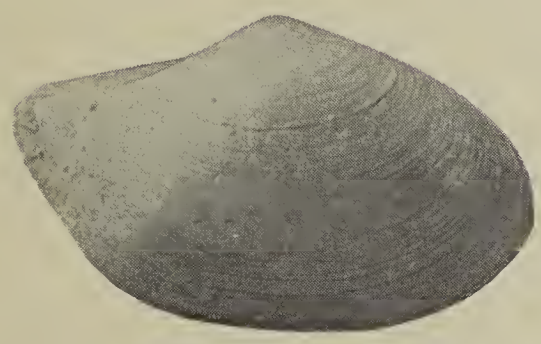

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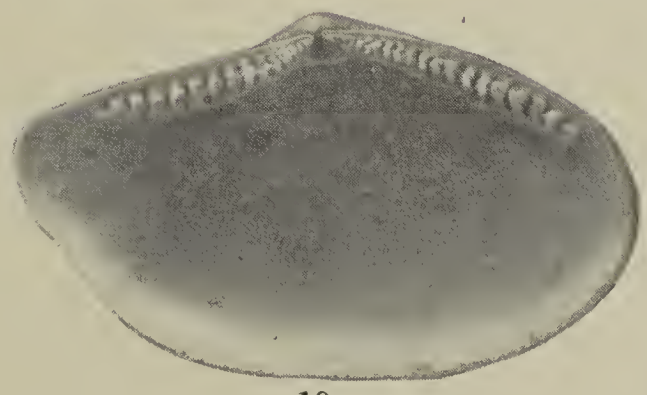

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1. Nucula (Nucula) morantensis × 4.
2, 3. Nucula (Nuculopsis) hilli, × 2.
4, 5. Leda (Saccella) peltella, × 4.
6, 7. Leda (Saccella) subcerata, × 4.
8 to 10. Leda (Saccella) indigena, × 4.
11, 12. Leda (Jupiteria) bowdenensis bowdenensis, × 4.
13, 14. Leda (Jupiteria) bowdenensis subtumida, × 4.
15, 16. Leda (Jupiteria) duerdeni, × 4.
17 to 19. Leda (Pseudoportlandia) clara, × 4.
20, 21. Yoldia (Orthoyoldia) ovalis, × 4.
22, 23. Tindaria (Tindaria) sp., × 10.

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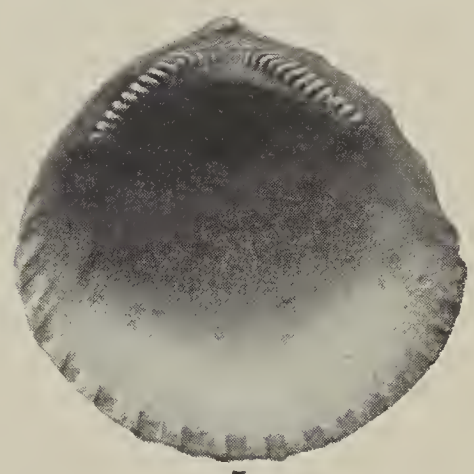

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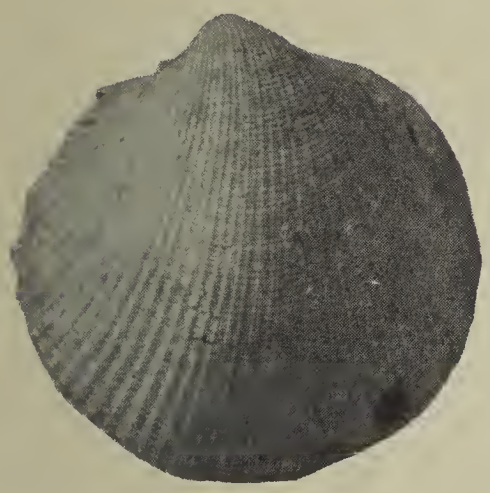

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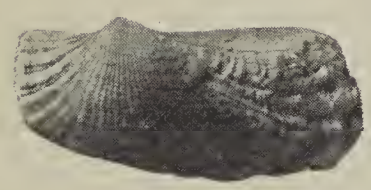

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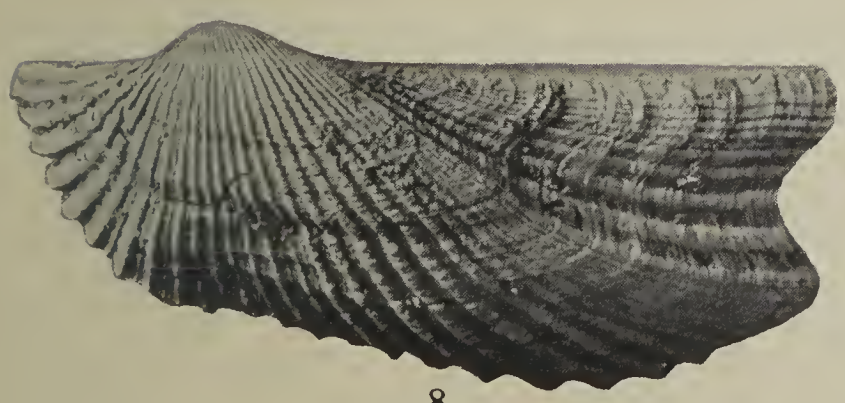

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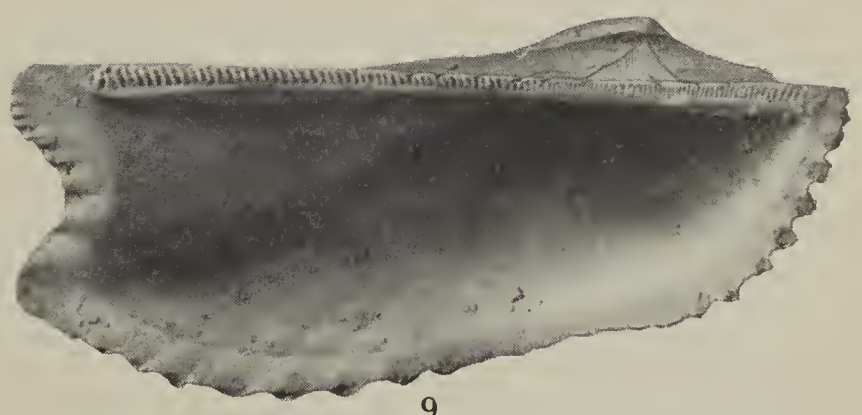

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1 to 3. Glycymeris (Glycymeris) jamaicensis, × 1.5.

4, 5. Glycymeris (Glycymeris) acuticostata plasia, × 1.5.

6, 7. Glycymeris (Glycymerella) prepennacea, × 1.5.

8, 9. Arca (Arca) occidentalis, × 1.

10, 11. Arca (Arca) umbonata morantensis, × 1.5

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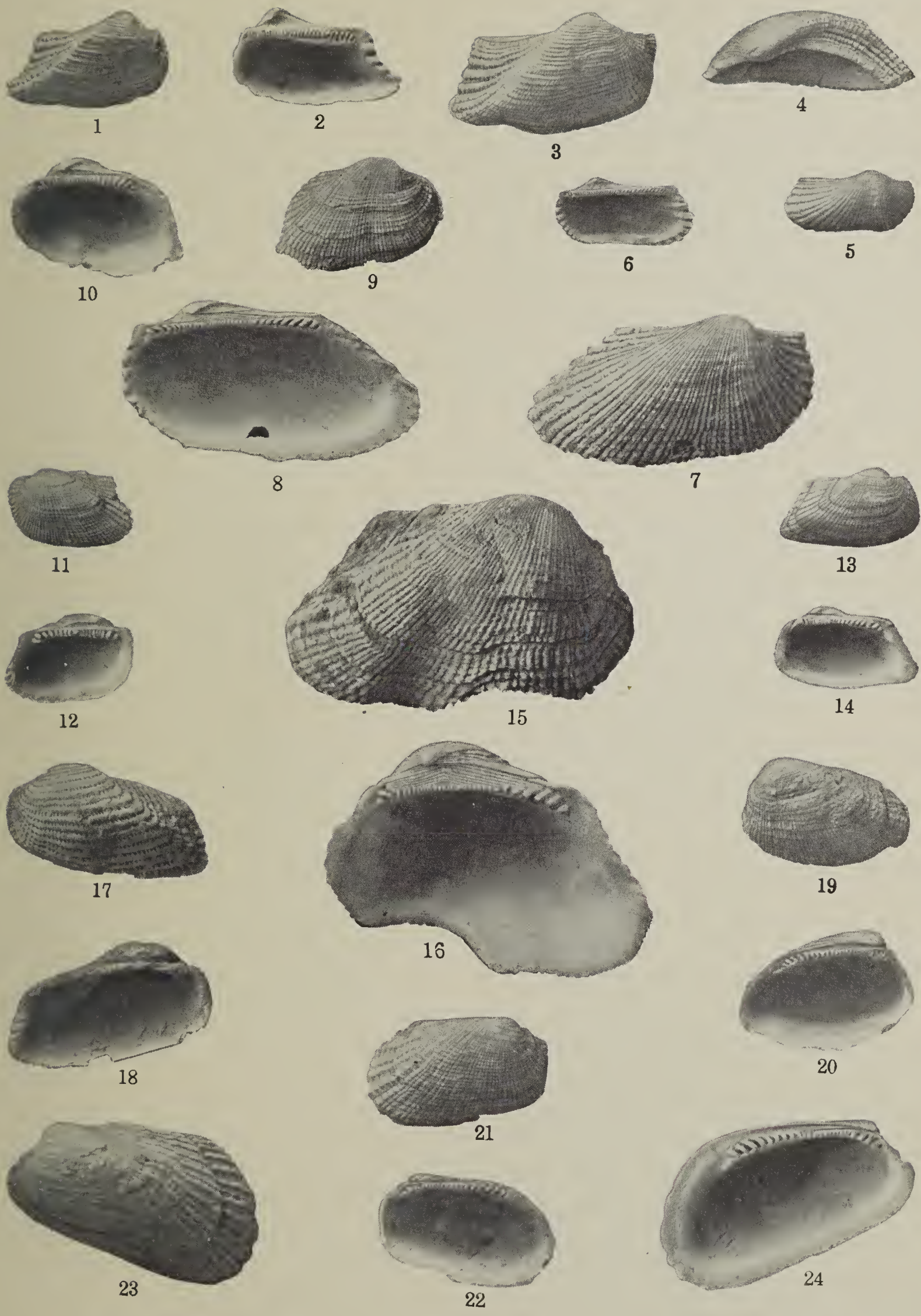

1 to 4. Arca (Arca) bowdeniana, × 2.
5, 6. Arca (Arca) yaquensis berryi, × 2.
7, 8. Barbatia (Barbatia) islopa, × 1.5.
9, 10. Barbatia (Barbatia) propertua, × 3.
11, 12. Barbatia (Barbatia) delepida, × 3.
13, 14. Barbatia (Barbatia) endomena, × 2.
15, 16. Barbatia (Barbatia) inusitata, × 1.5.
17, 18. Barbatia (Acar) domingensis, × 1.5.
19, 20. Barbatia (Obliquarca) dentera, × 1.5.
21, 22. Barbatia (Obliquarca) subcandida, × 2.
23, 24. Barbatia (Obliquarca) modiolida, × 4.

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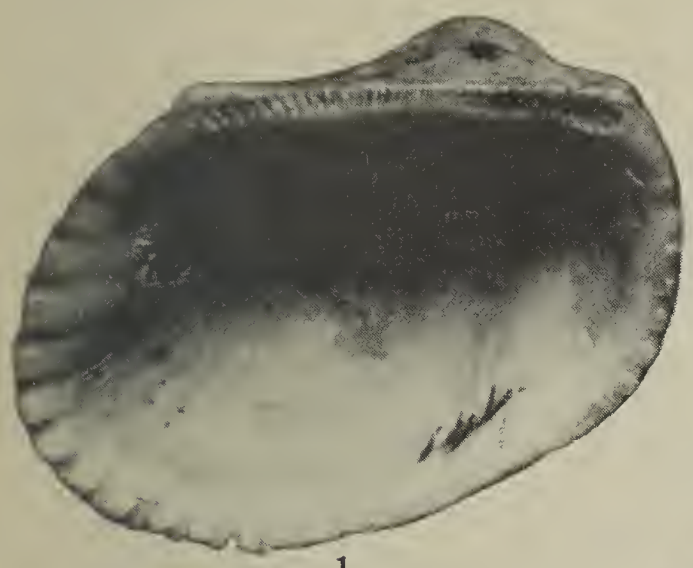

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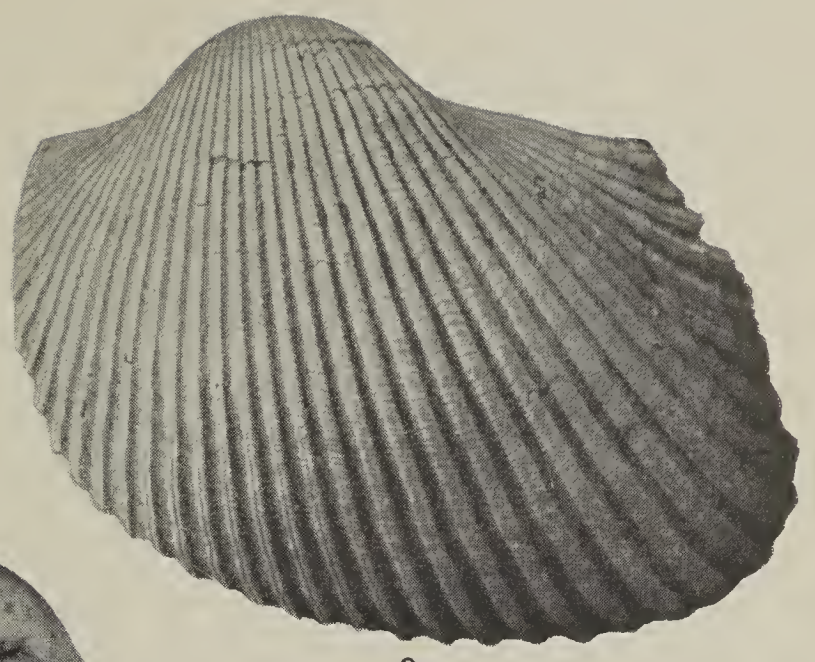

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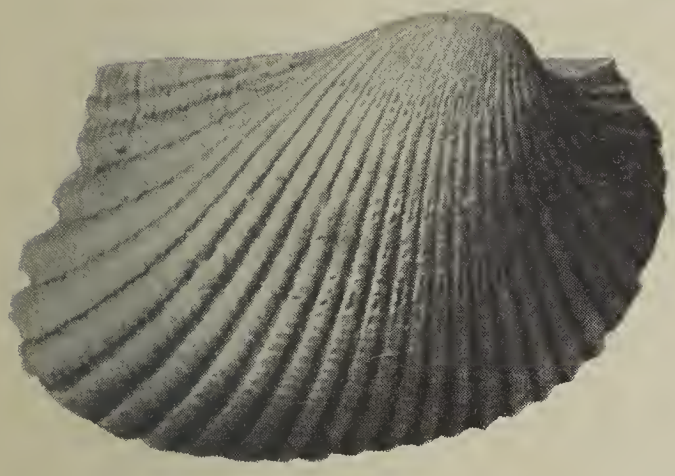

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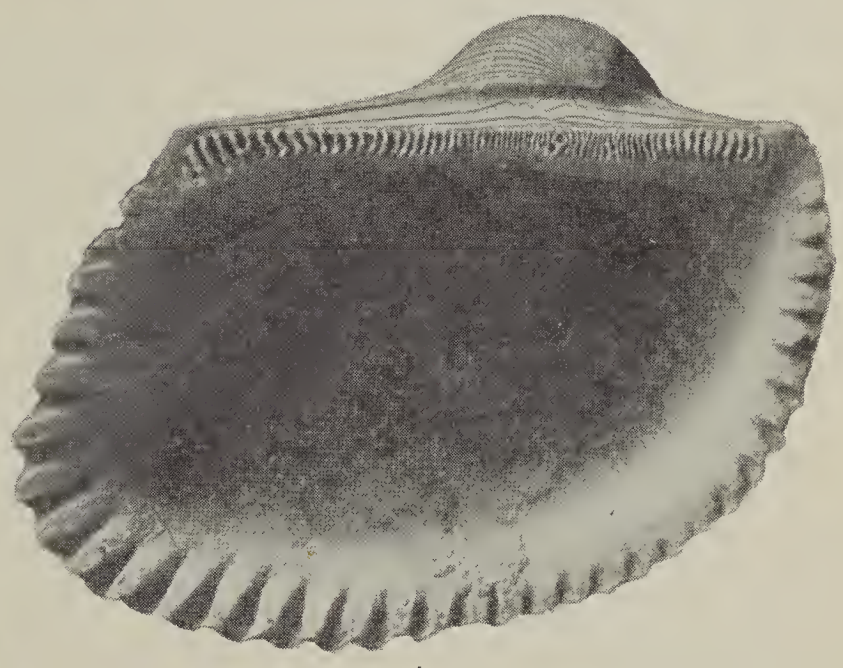

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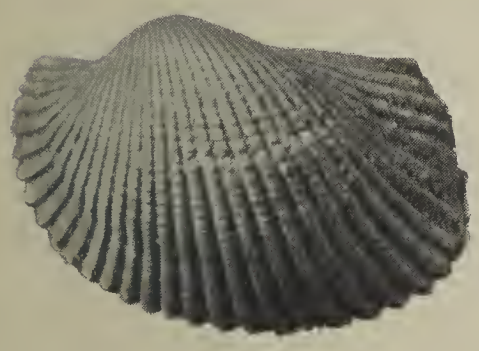

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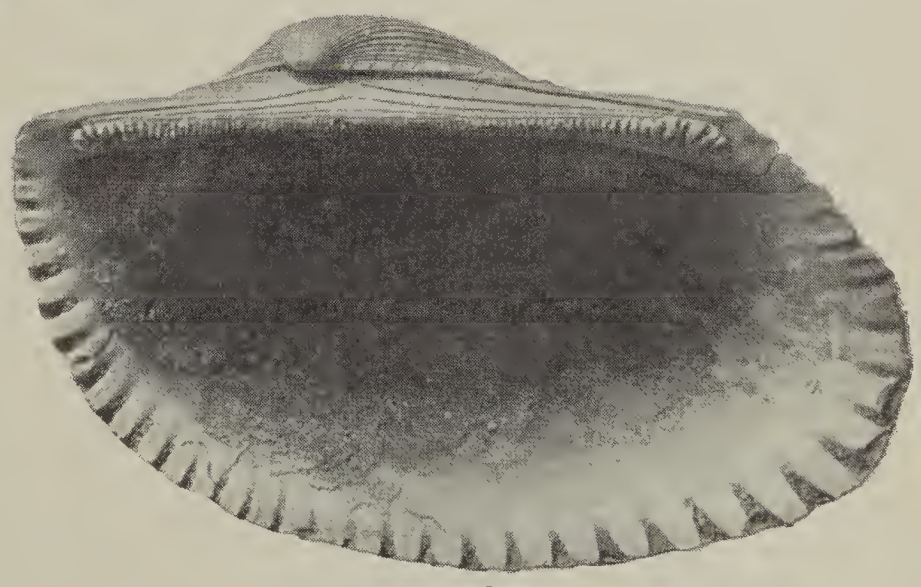

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1, 2. Arca antiquata.
3, 4. Barbatia (Diluvarca) halidonata halidonata, × 1.
5, 6. Barbatia (Diluvarca) halidonata oresta, × 1.
7. Barbatia (Diluvarca) perplura, × 1.5.
8. Barbatia (Diluvarca) prephina, × 1.5.

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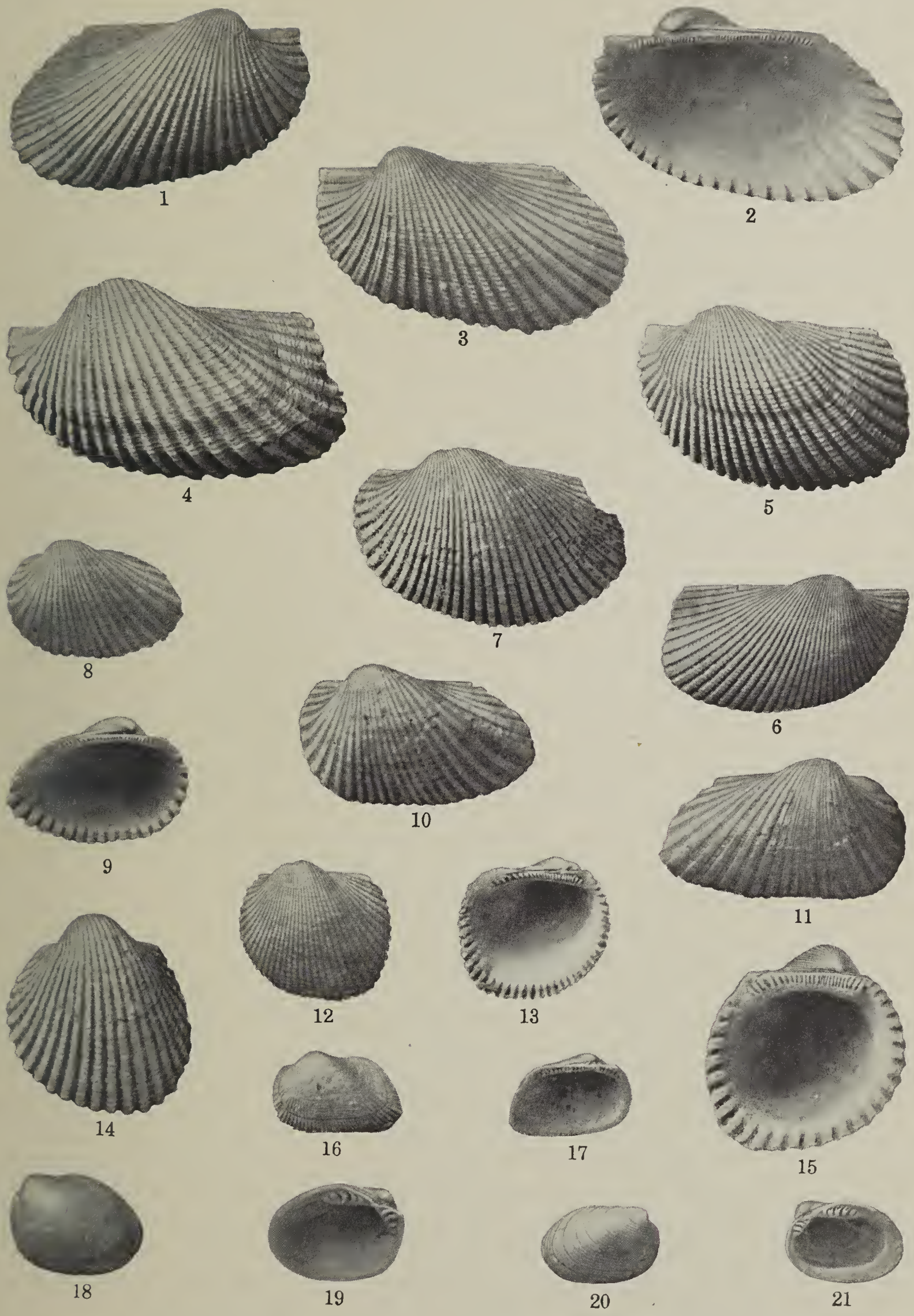

1 to 3. Barbatia (Diluvarca) inaequilateralis, × 1.5.
4. Barbatia (Diluvarca) dasia, × 1.5.
5. Barbatia (Diluvarca) wordeni, × 1.5.
6. Barbatia (Diluvarca) agnastha, × 1.5.
7. Barbatia (Diluvarca) thomasensis × 2.
8 to 11. Barbatia (Diluvarca) donacia, × 4.
12, 13. Barbatia (Diluvarca) microtera, × 4.
14, 15. Barbatia (Diluvarca) ophthanta, × 4.
16, 17. Fossularca (Fossularca) adamsi sawkinsi, × 2.
18 to 21. Fossularca (Ovalarca) ovalina, × 6.

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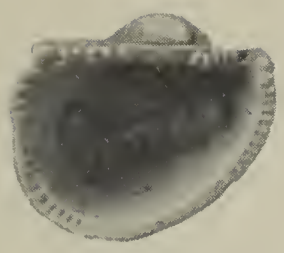

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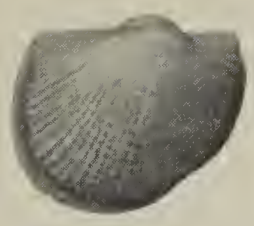

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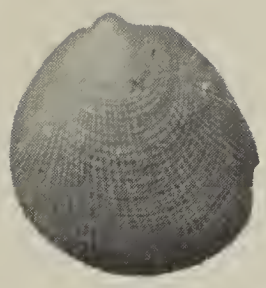

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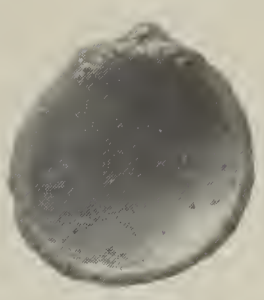

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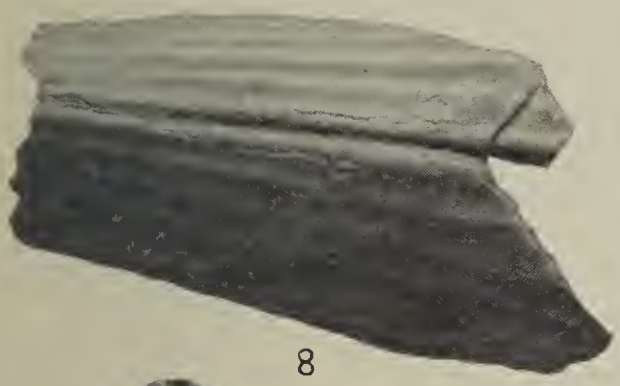

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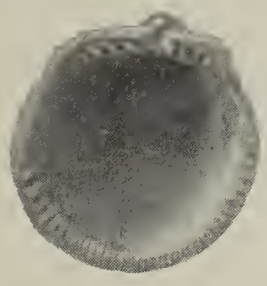

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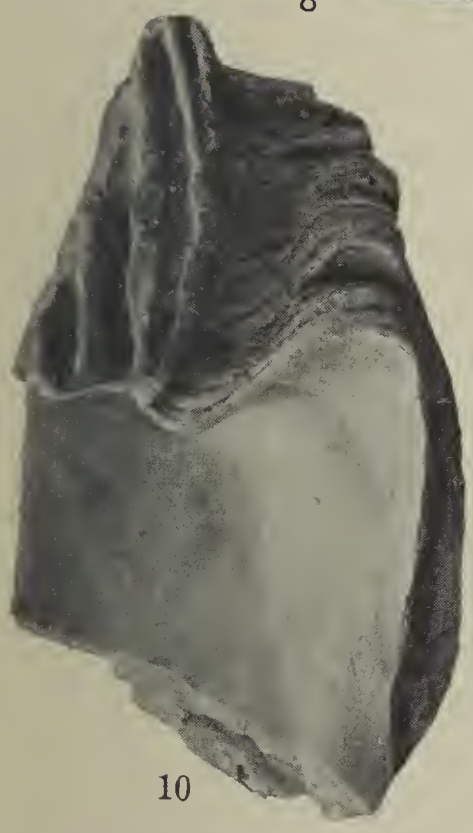

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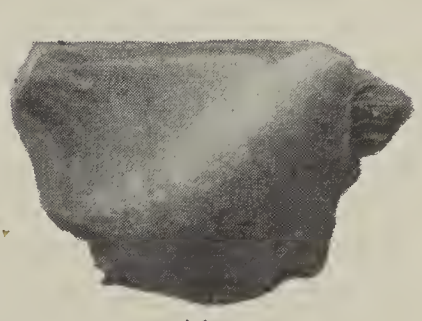

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1 to 3. Bathyarca hendersoni, × 10.
4 to 5. Limopsis (Pectunculina) ovalis silova, × 4
6, 7. Limopsis (Pectunculina) jamaicensis, × 10.
8. Pinna refurca, × 1.5.
9. Atrina sp., × 1.5.
10. Isognomon sp., × 1.5.
11. Pteria inornata, × 2.
12 to 14. Ostrea (Lopha) paramegodon, × 1.5.

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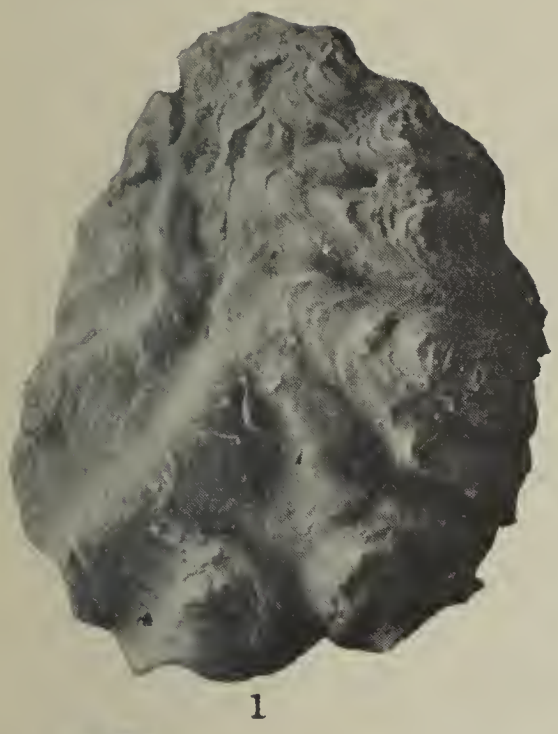

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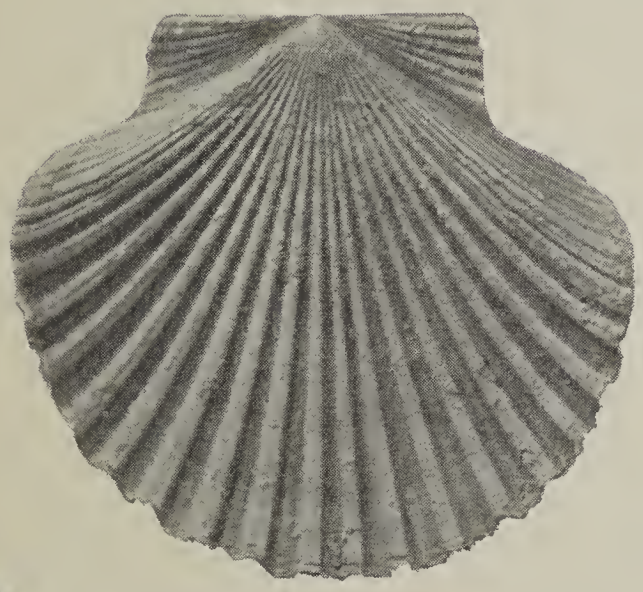

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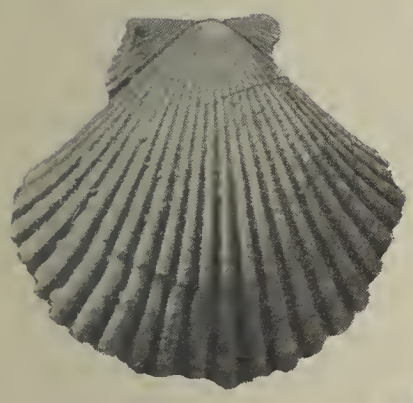

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1, 2. Ostrea (Lopha) guppyi, × 1.5.
3 to 5. Ostrea (Lopha) folioides, × 1.5.
6, 7. Pecten (Pecten) barretti, × 1.
8, 9. Pecten (Euvola) bowdenensis, × 1.
10. Chlamys (Chlamys) sp., × 6.

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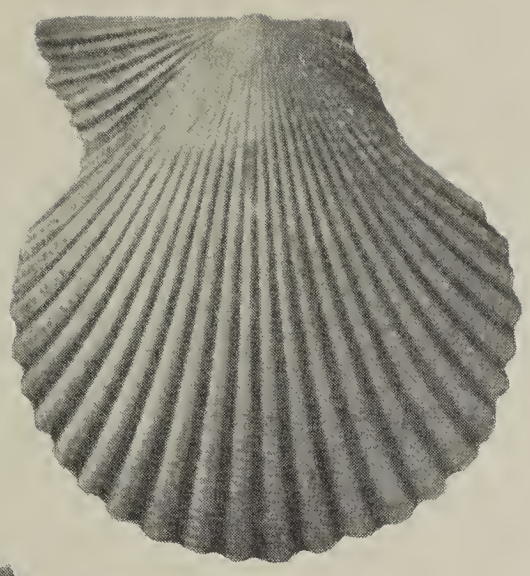
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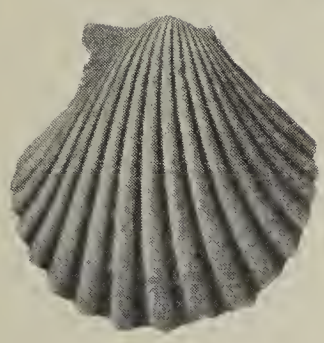
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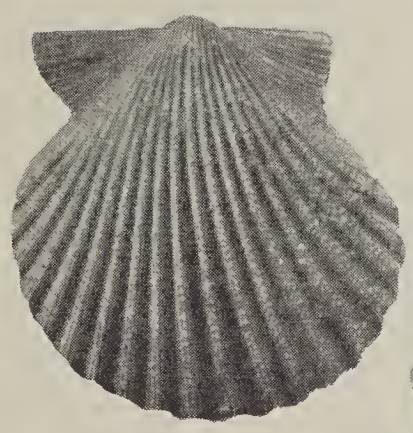
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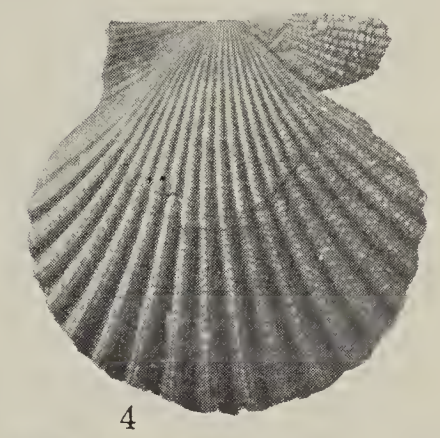
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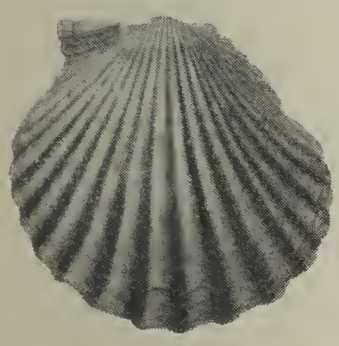
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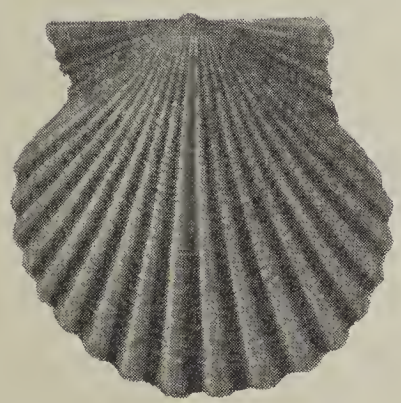
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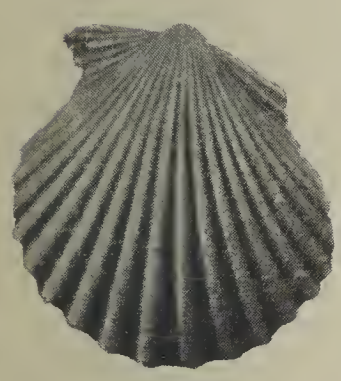
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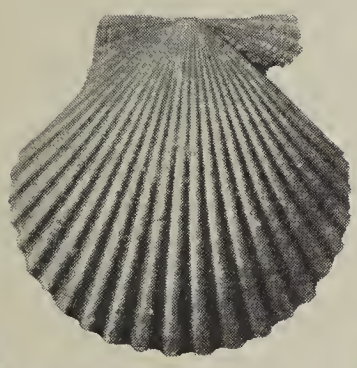
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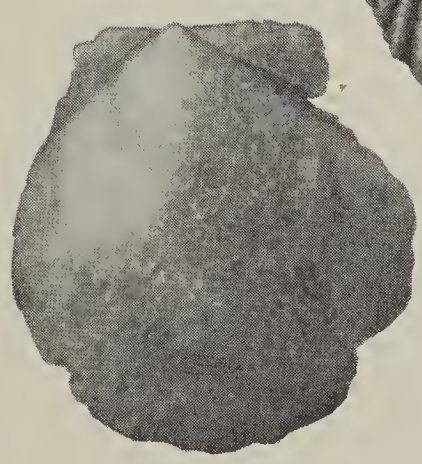
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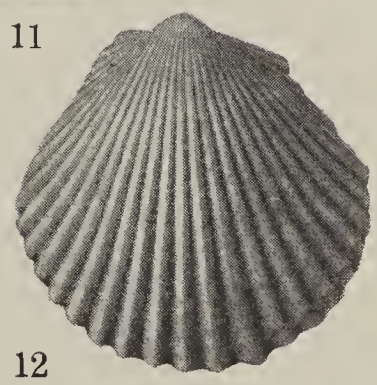
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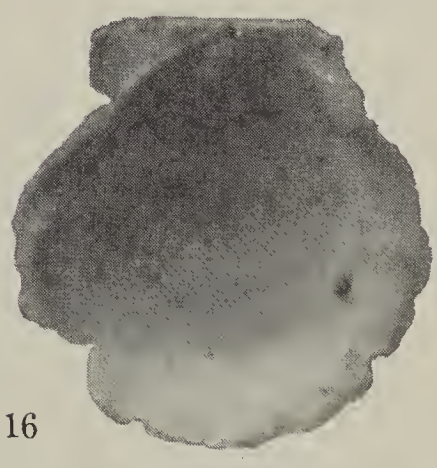
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1, 2. Chlamys (Chlamys) vaginulus, × 3.
3. Chlamys (Chlamys) bellipictus, × 6.
4, 5. Chlamys (Aequipecten) plurinominis morantensis, × 1.
6, 7. Chlamys (Plagioctenium) uselmae, × 1.
8. Chlamys (Plagioctenium) concinnatus, × 2.
9. Chlamys (Plagioctenium) ameleus, × 2.
10. Chlamys (Plagioctenium) mansfieldi, × 4.
11, 12. Chlamys (Plagioctenium) gonioides, × 2.
13 to 16. Chlamys (Palliolum?) guppyi, × 8.

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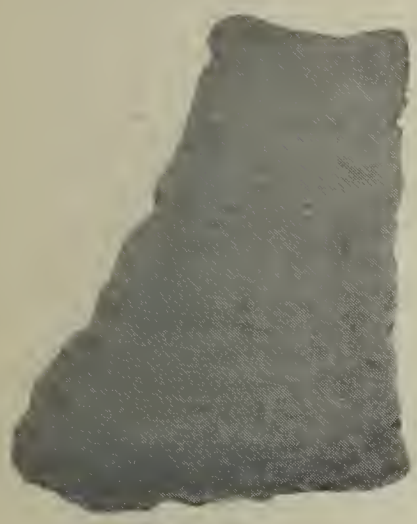

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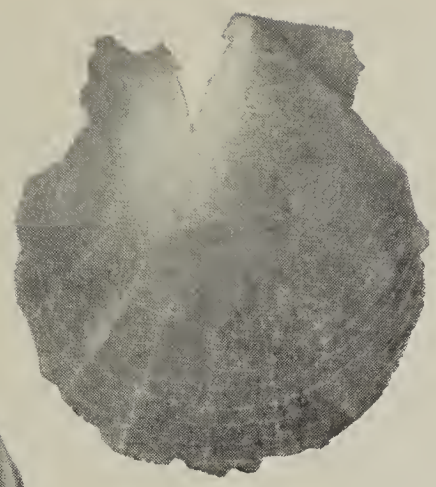

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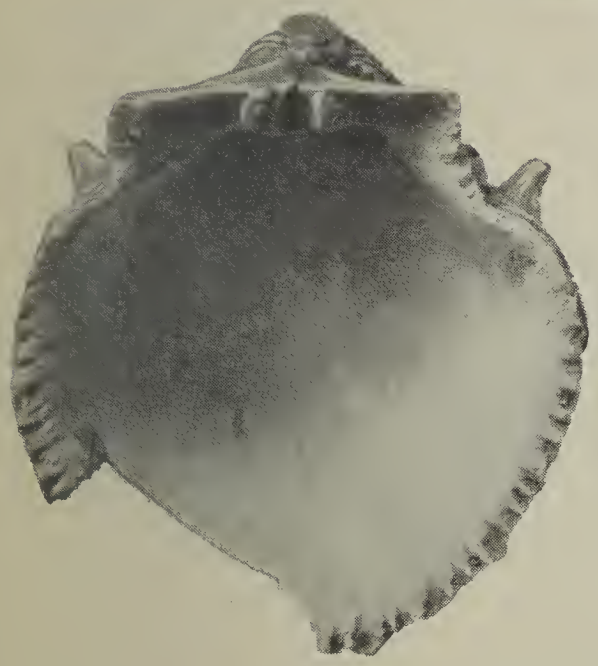

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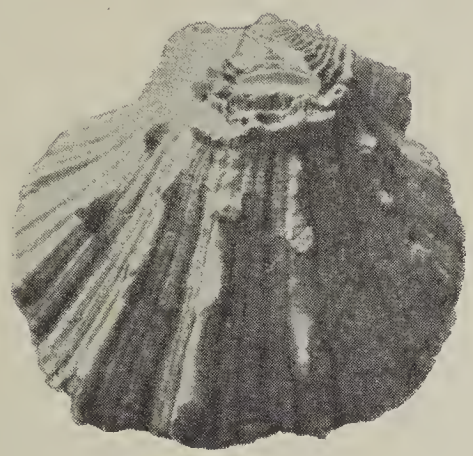

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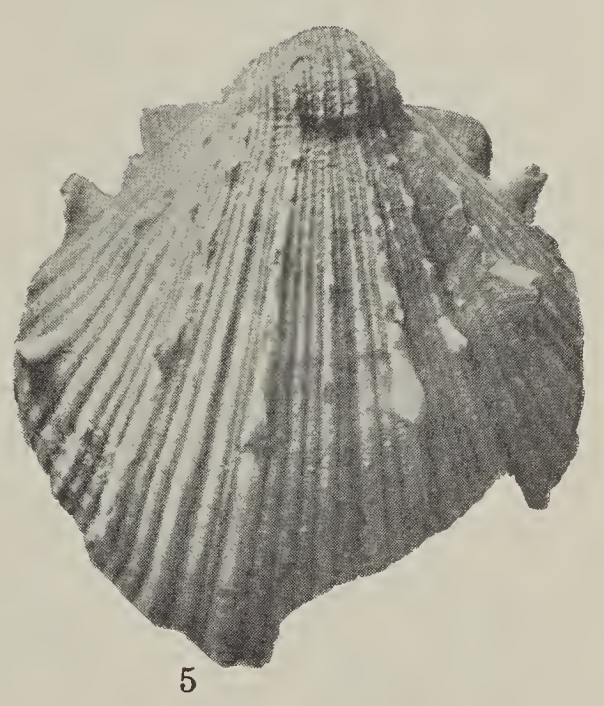

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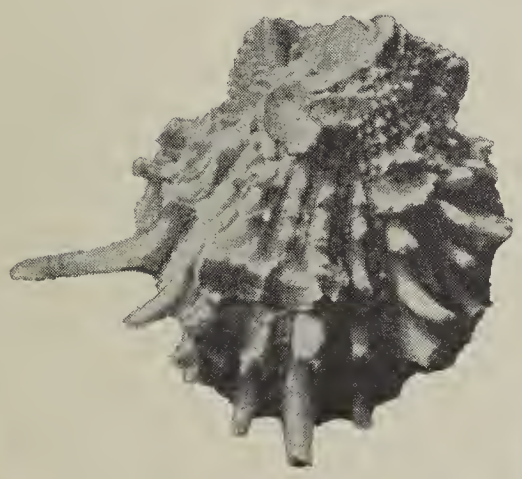

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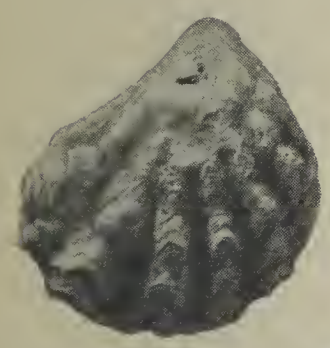

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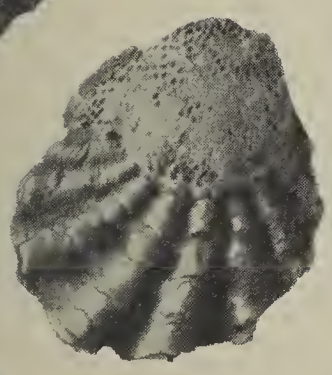

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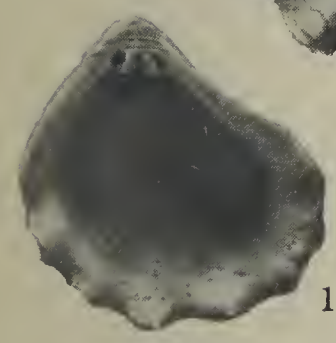

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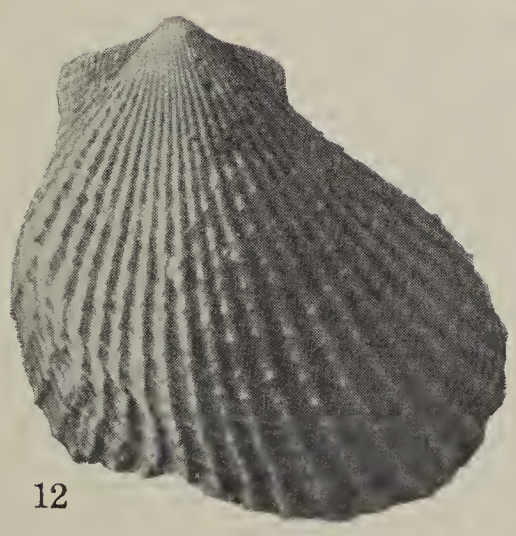

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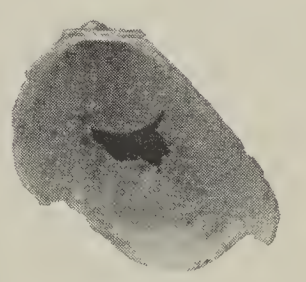

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1, 2. Amusium (Amusium) papyraceum? × 1.
3, 4. Amusium (Parvamussium) spendulum, × 6.
5, 6. Spondylus bostrychites, × 1.
7. Spondylus bostrychites, × 1.5.
8. Spondylus sp., × 3.
9 to 11. Plicatula guppyi, × 2.
12, 13. Lima (Lima) stenacostata, × 4.
14, 15. Lima (Mantellum) sp., × 4.

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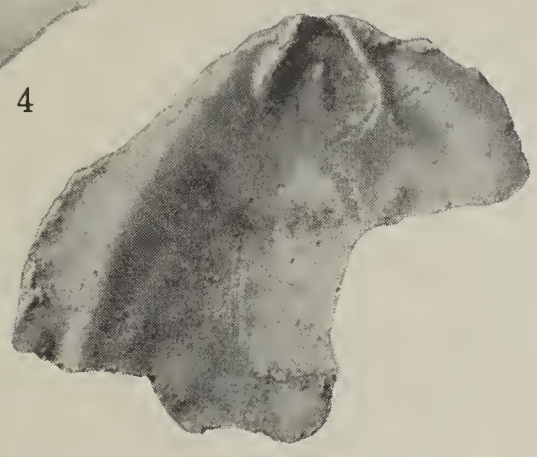
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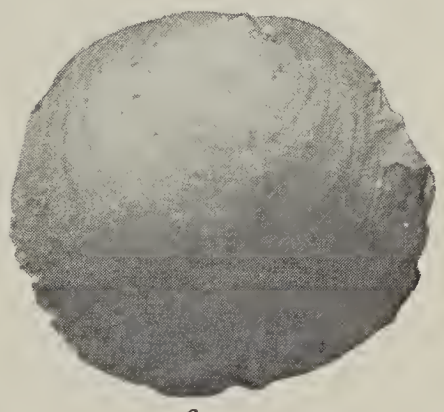
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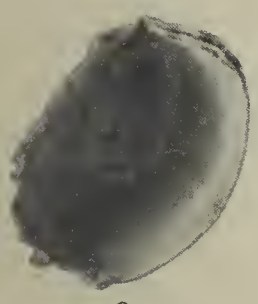
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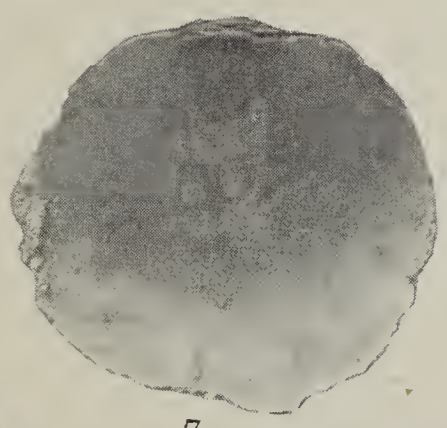
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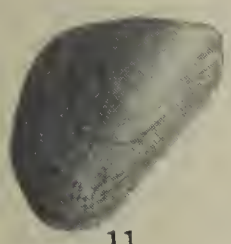
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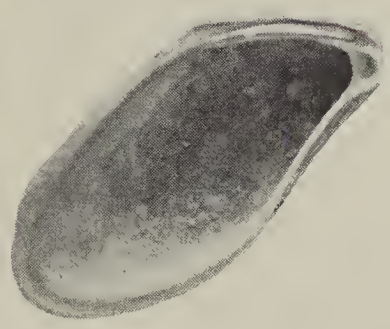
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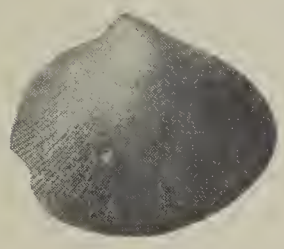
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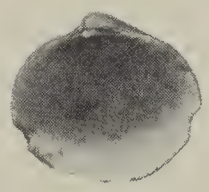
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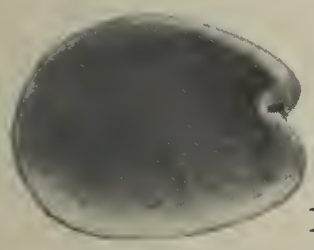
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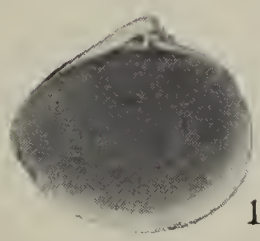
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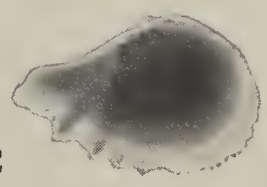
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1, 2. Limea solida, × 8.
3, 5. Placunanomia lithobleta, × 1.
6 to 9. Anomia indecisa, × 2.
10 to 12. Modiolus (Brachydontes) guppyi, × 4.
13, 14. Mytilopsis jamaicensis, × 2.
15, 16. Julia gardnerae, × 3.
17 to 19. Poromya jamaicensis, × 4.
20 to 22. Cuspidaria (Cardiomya) craspedonia, × 6.

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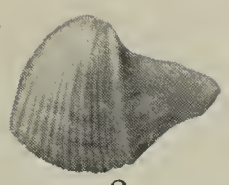
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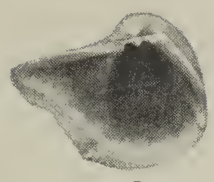
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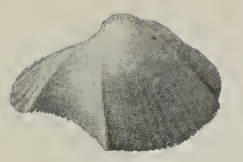
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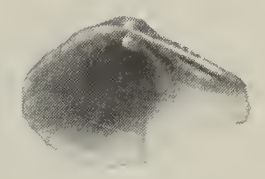
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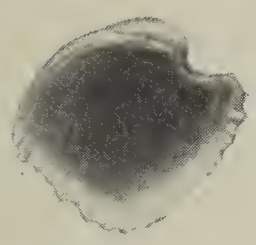
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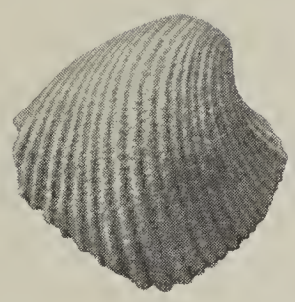
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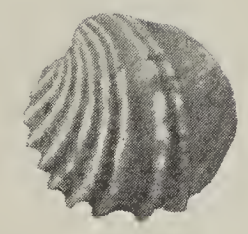
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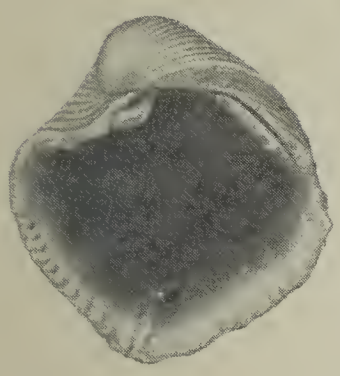
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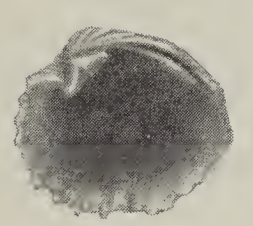
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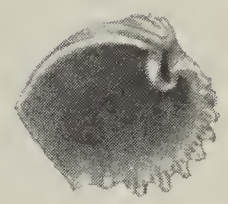
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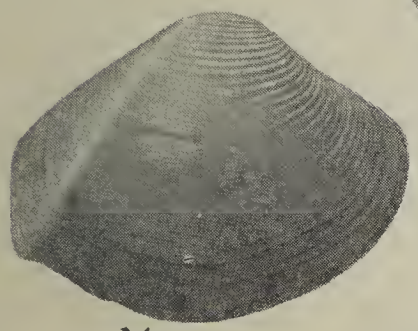
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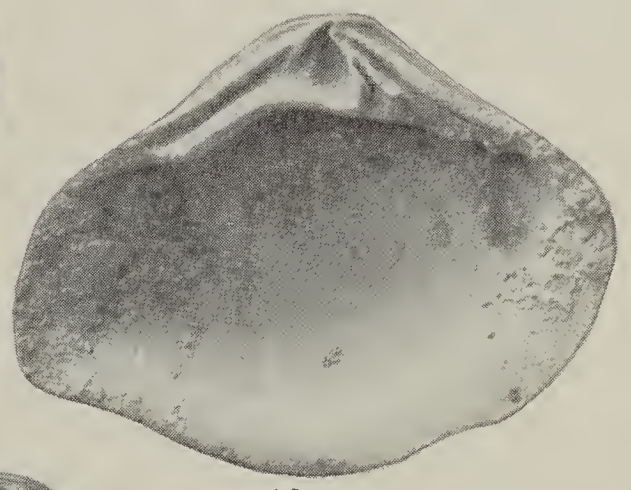
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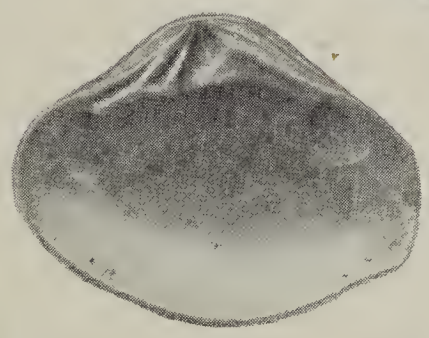
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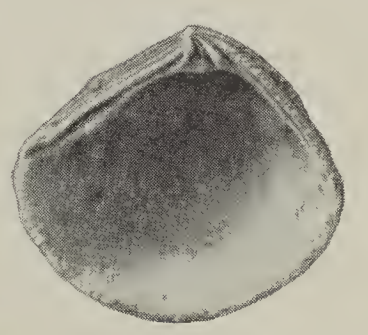
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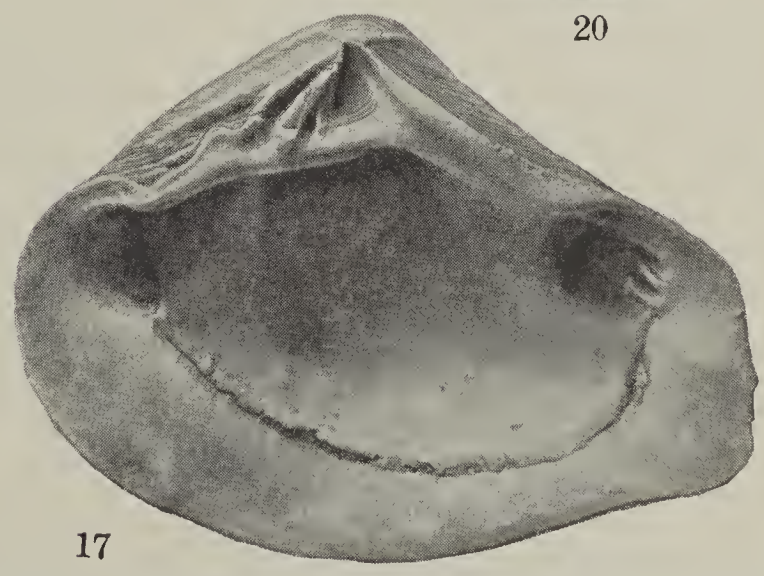
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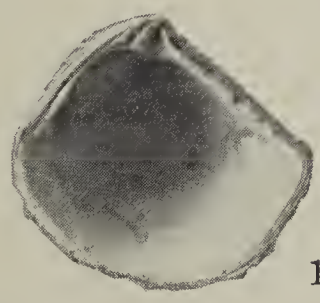
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1 to 5. Cuspidaria (Bowdenia) distira, × 6.
6 to 8. Verticordia (Trigonulina) bowdenensis, × 6.
9 to 11. Verticordia (Haliris) jamaicensis, × 6.
12 to 15. Crassatellites (Crassatellites) jamaicensis, × 1.
16, 17. Crassatellites (Crassatellites) altaspissus, × 1.
18 to 20. Crassinelli guppyi, × 6.

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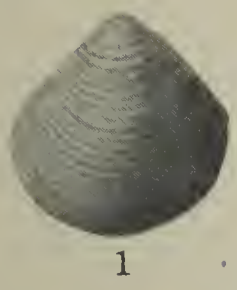
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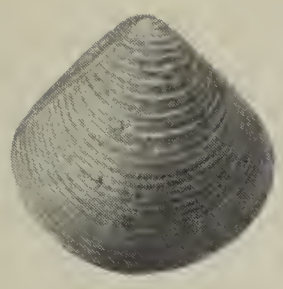
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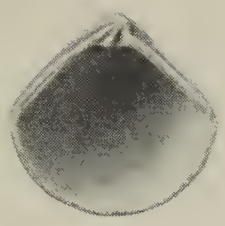
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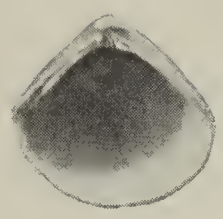
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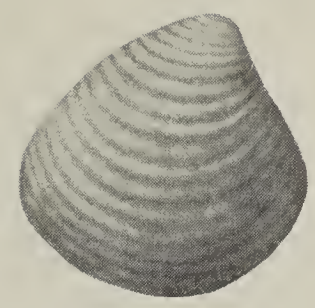
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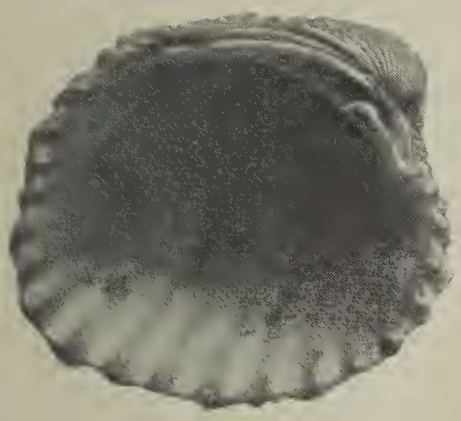
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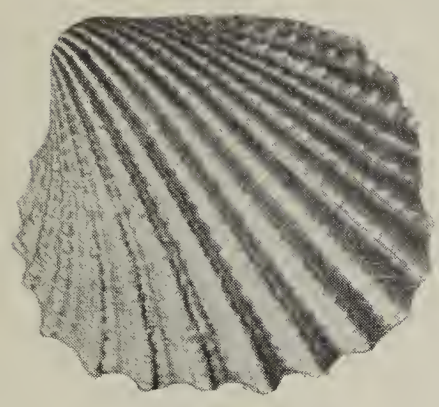
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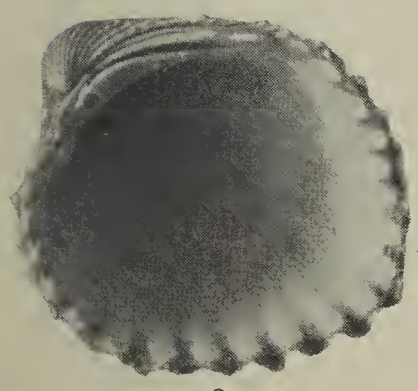
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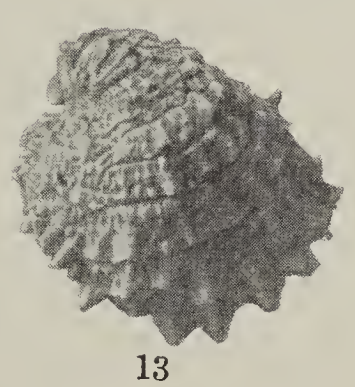
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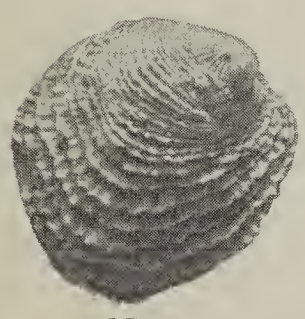
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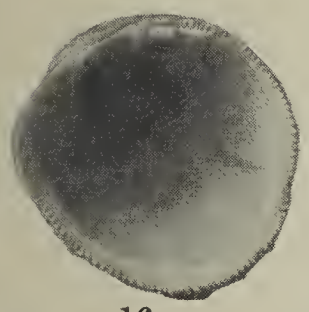
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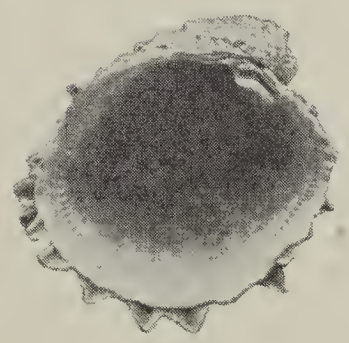
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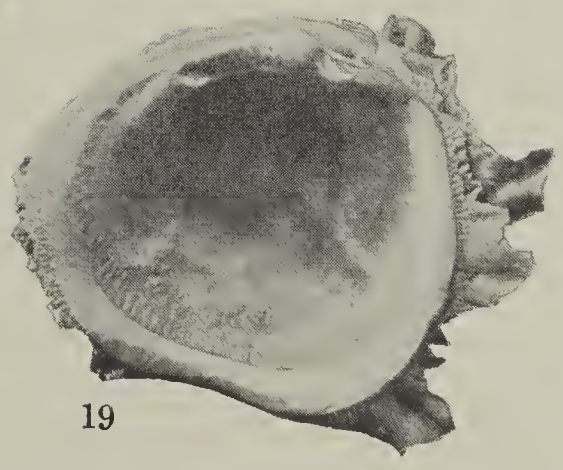
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1 to 4. Crassinella bowdenensis, × 6.
5, 6. Crassinella xena, × 10.
7 to 9. Cardita (Glans) scabricostata, × 2.
10 to 12. Venericardia (Pleuromeris) acaris, × 6.
13 to 16. Chama involuta, × 2.
17. Chama involuta, × 6.
18, 19. Chama macerophylla, × 1.5.

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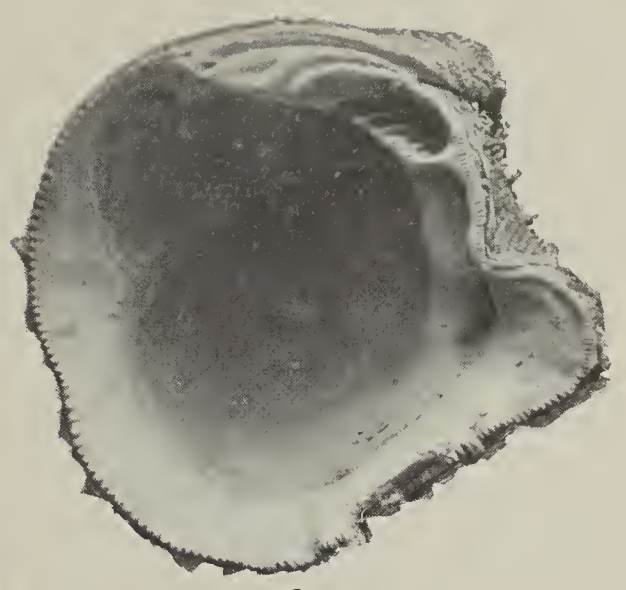

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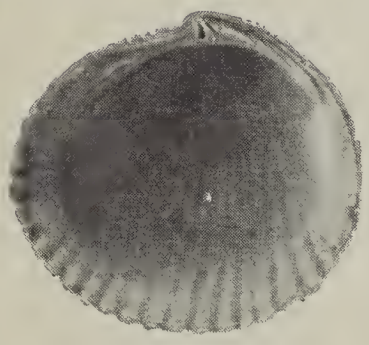

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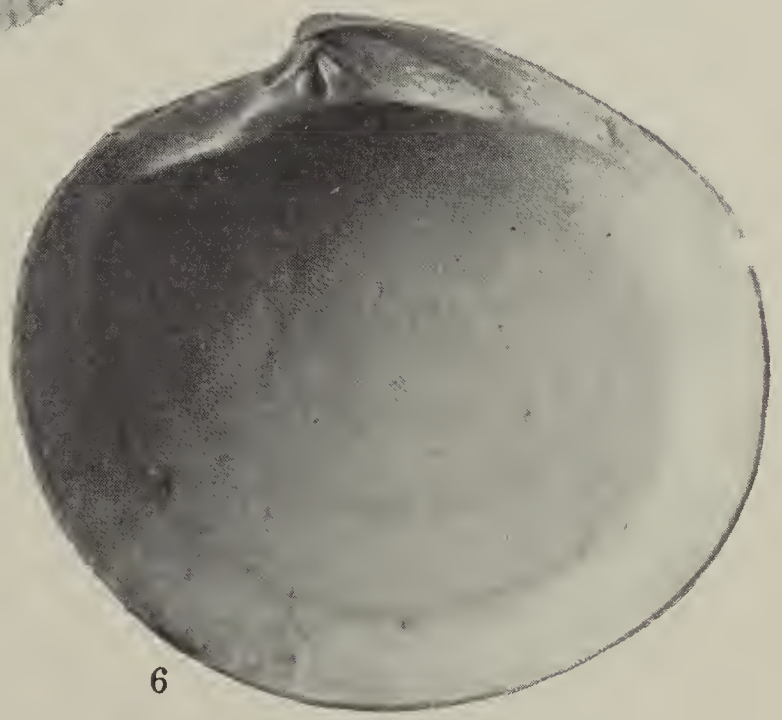

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1 to 4. Echinochama antiquata, × 1.
5, 6. Codakia (Codakia) spinulosa, × 2.
7, 8. Codakia (Codakia) lomonea, × 2.

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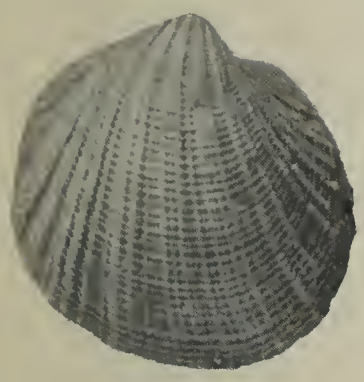

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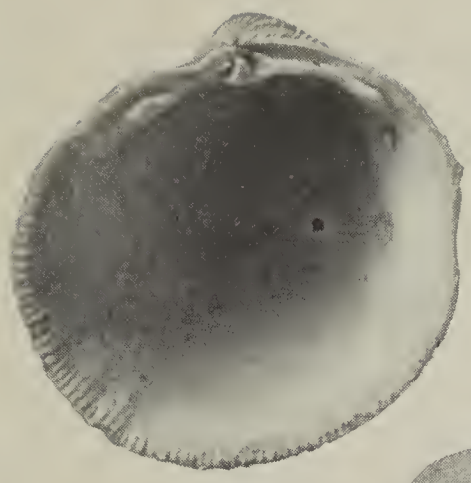

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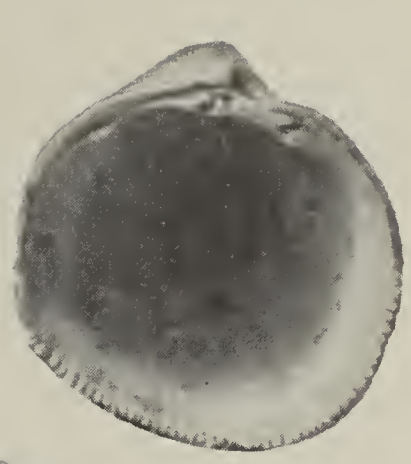

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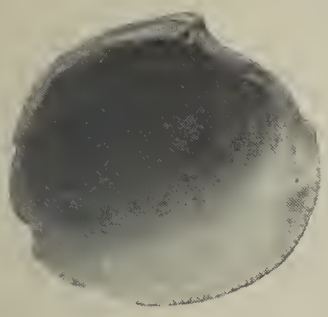

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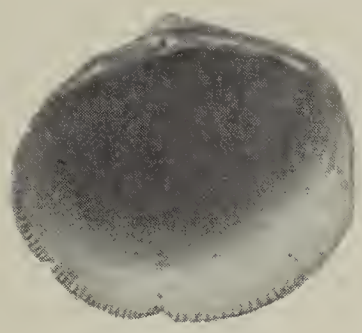

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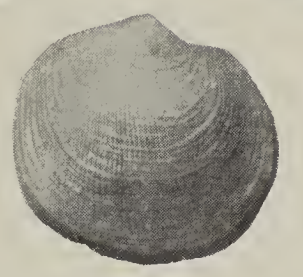

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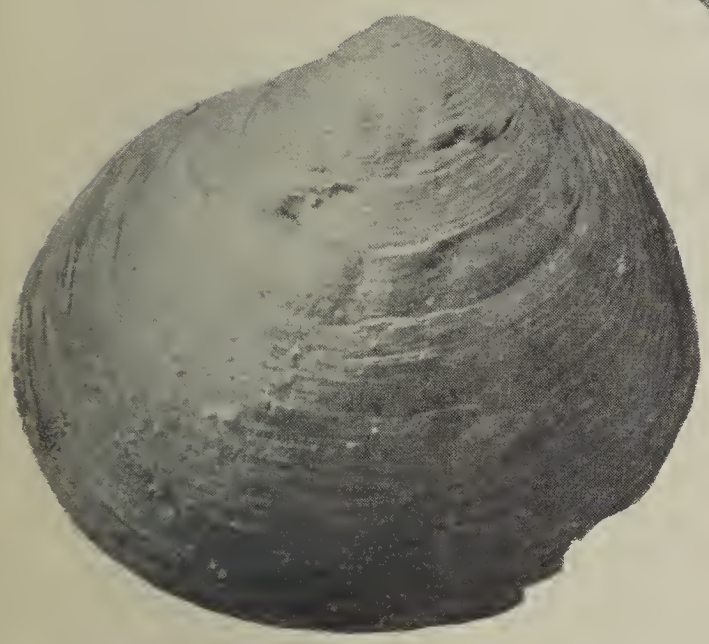

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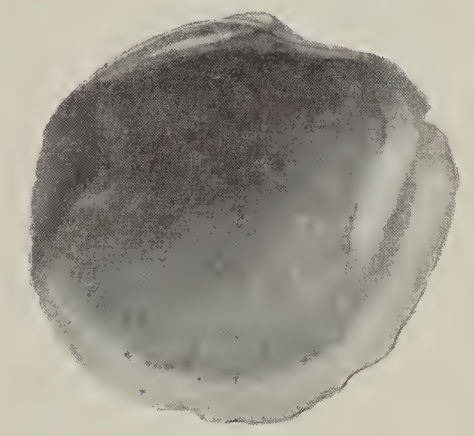

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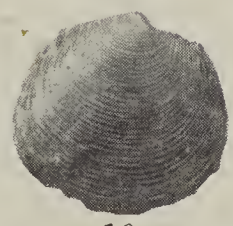

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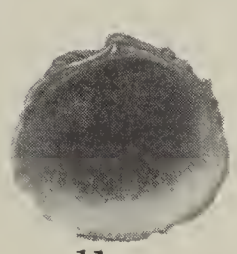

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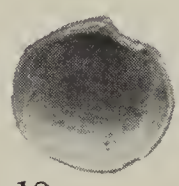

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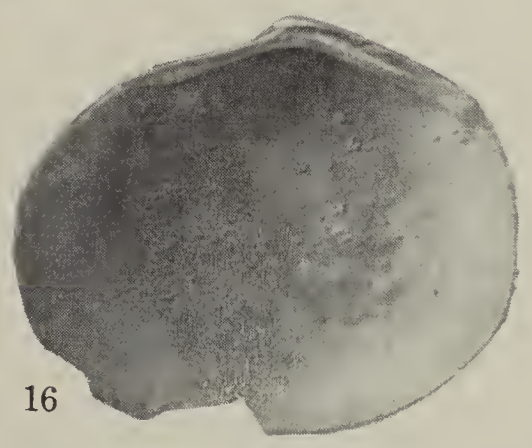

16

1 to 4. Codakia (Jagonia) vendryesi, × 4.
5 to 7. Codakia (Jagonia) guppyi, × 2.
8, 9. Lucina (Lucina) bowdenensis, × 1.5.
10 to 12. Myrtaea (Myrtaea) limoniana, × 2.
13 to 16. Myrtaea (Myrtaeopsis) pertenera, × 1.5.

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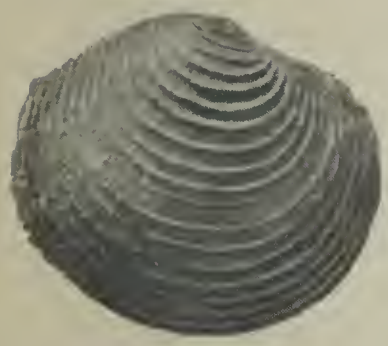

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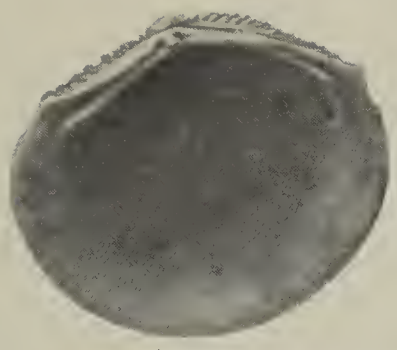

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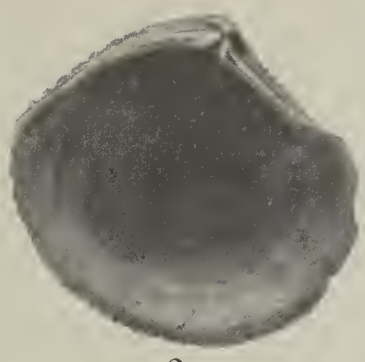

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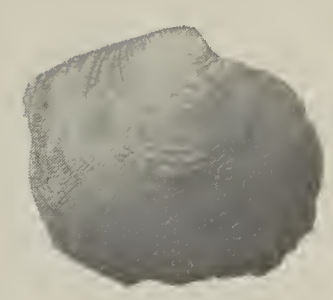

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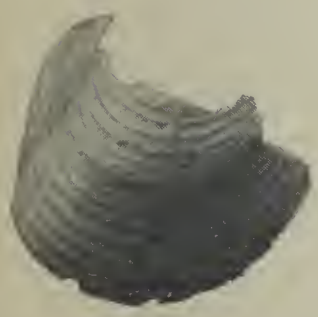

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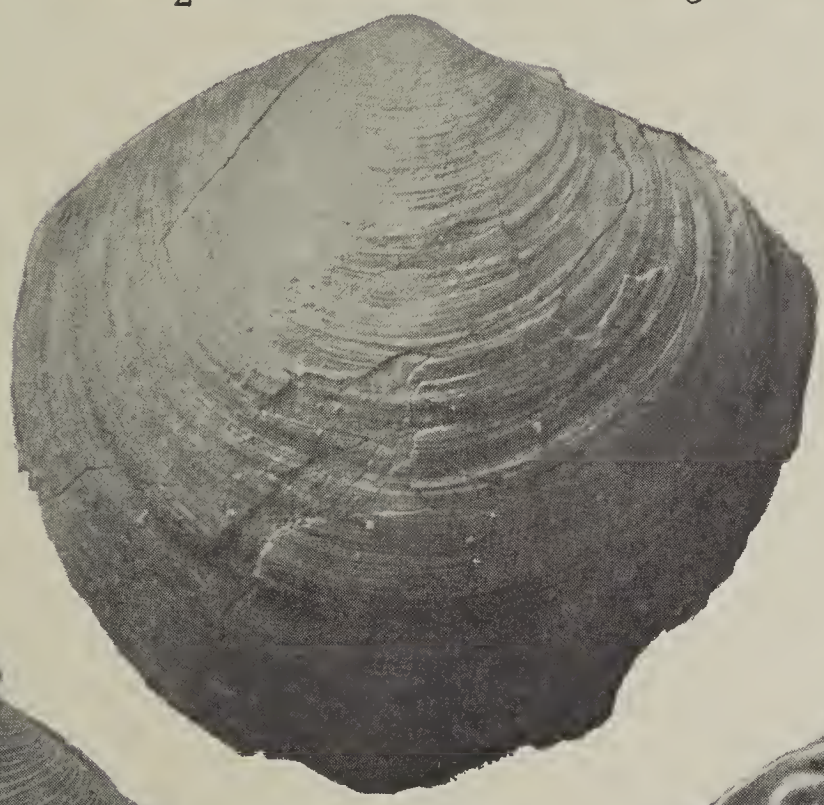

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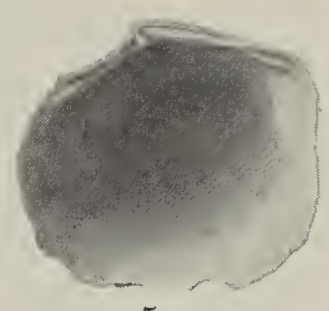

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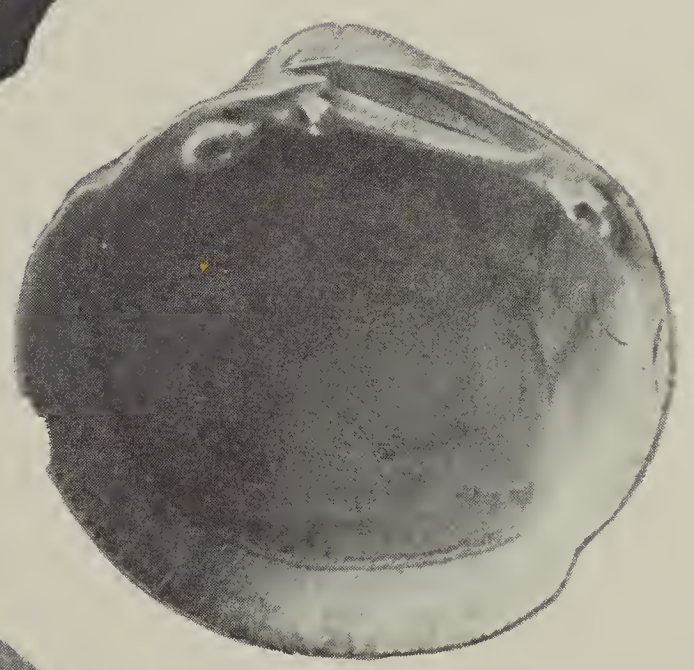

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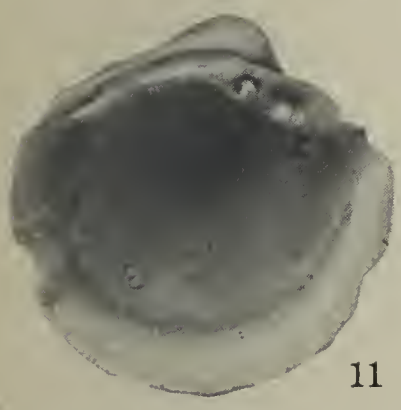

11

12

1 to 3. Myrtaea (Eulopia) vermiculata, × 4.
4, 5. Myrtaea (Eulopia) furcata, × 2.
6. Miltha (Megaxinus) gluminda, × 1.5.
7. Phacoides (Phacoides?) sp., × 1.5.
8 to 11. Phacoides (Linga) podagrinus podagrinus, × 1.5.
12. Phacoides (Linga) podagrinus alarantus, × 1.

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1. Phacoides (Linga) browni, × 1.
2, 3. Phacoides (Linga) tithonis, × 6.
4 to 6. Phacoides (Pleurolucina) quadricostatus, × 6.
7, 8. Phacoides (Cardiolucina) recurrens, × 4.
9 to 13. Phacoides (Callucina) pauperatus pauperatus, × 2.
14, 15. Phacoides (Callucina) pauperatus oligocostatus, × 2.
16, 17. Phacoides (Callucina) eurycostatus, × 4.

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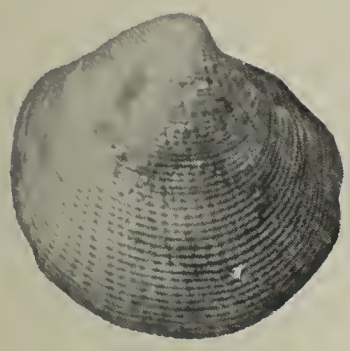
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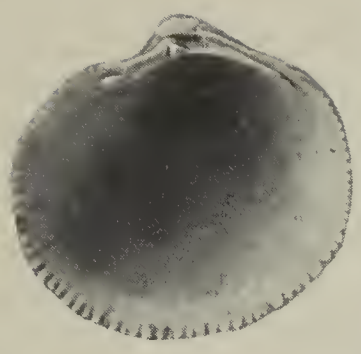
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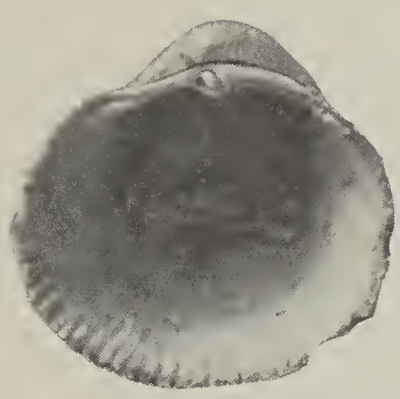
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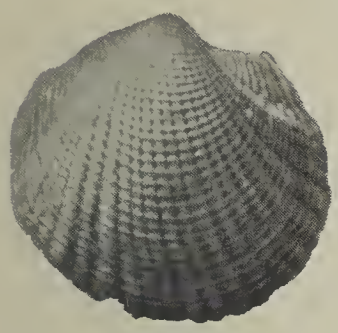
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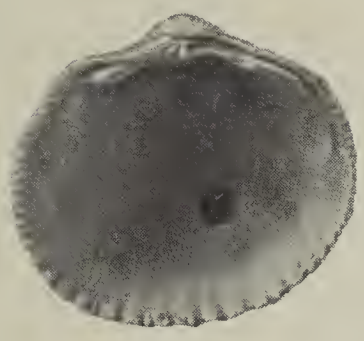
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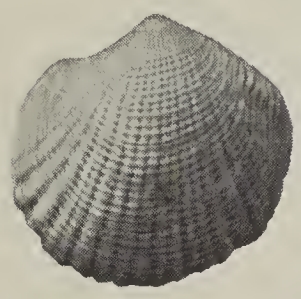
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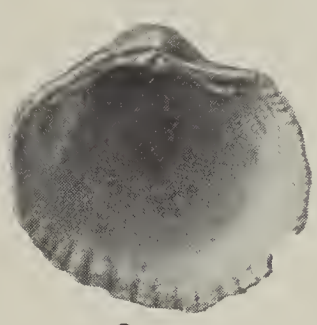
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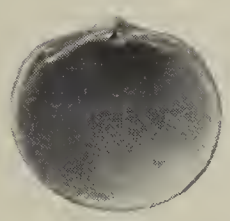
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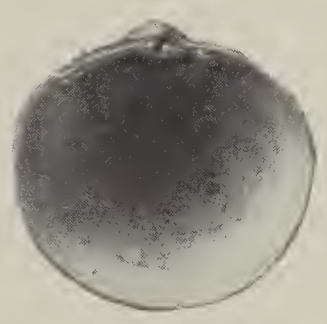
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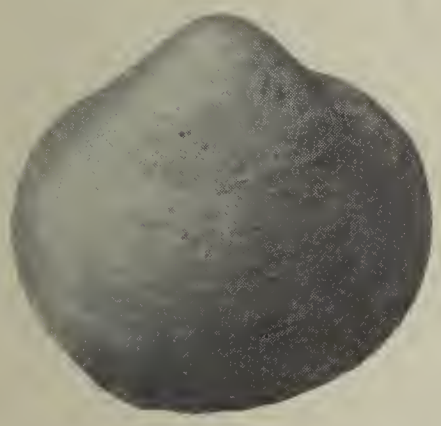
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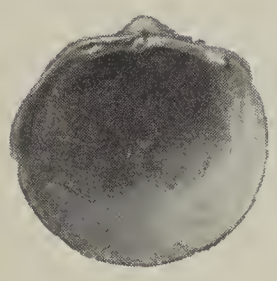
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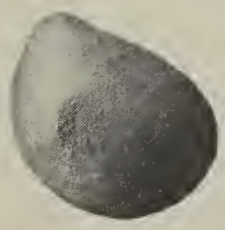
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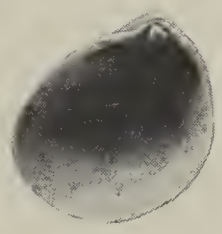
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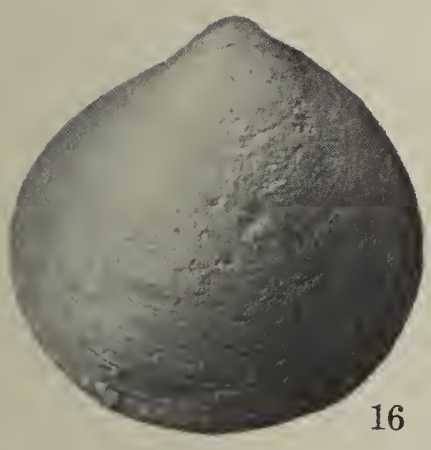
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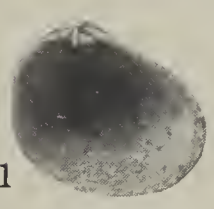
21

17

1, 2. Phacoides (Parvilucina) yaquensis morantensis, × 6.
3, 4. Phacoides (Parvilucina) limnidus, × 6.
5 to 8. Phacoides (Bellucina) actinus, × 6.
9 to 13. Divaricella (Divaricella) prevaricata, × 2.
14, 15. Diplodonta (Diplodonta) walli, × 6.
16, 17. Diplodonta (Diplodonta) homalostriata, × 6.
18 to 21. Diplodonta (Felaniella) minor, × 6.

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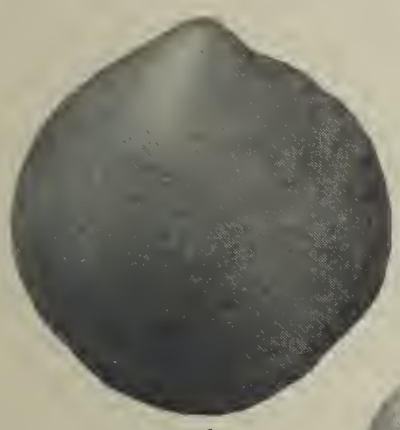
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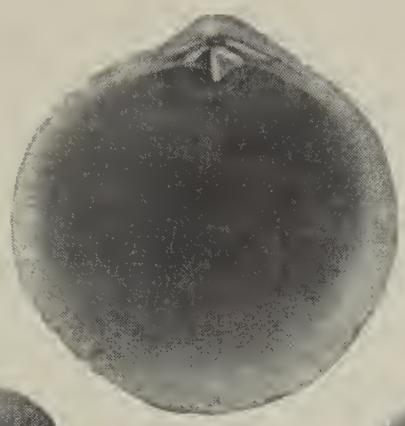
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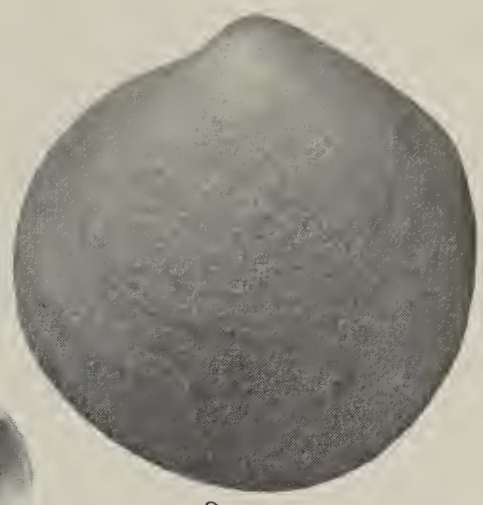
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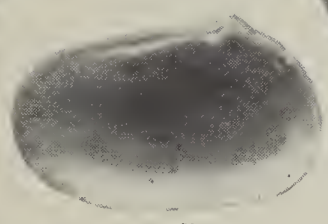
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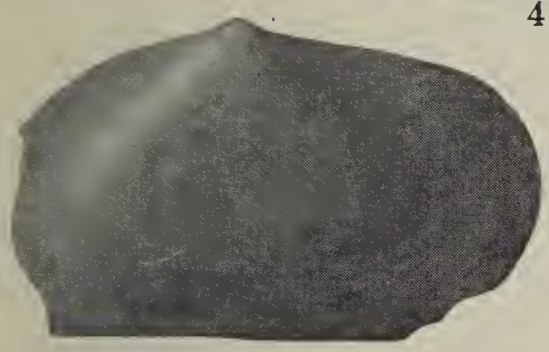
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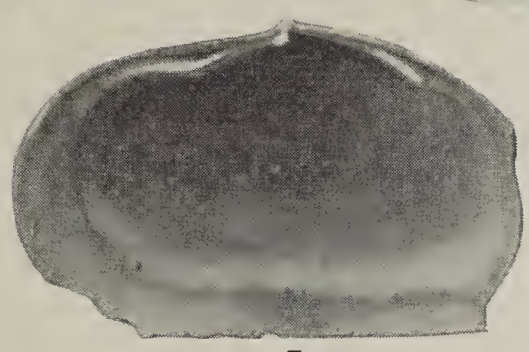
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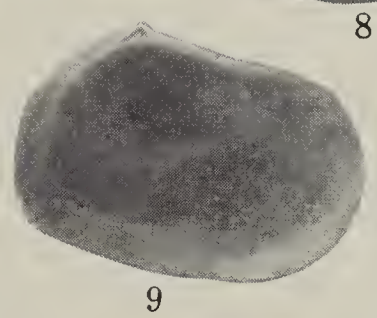
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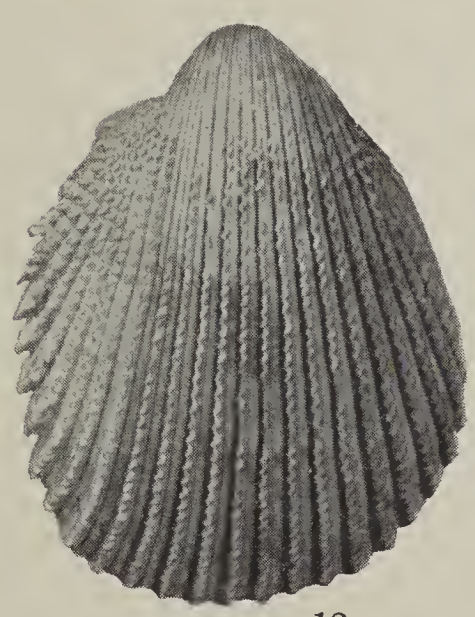
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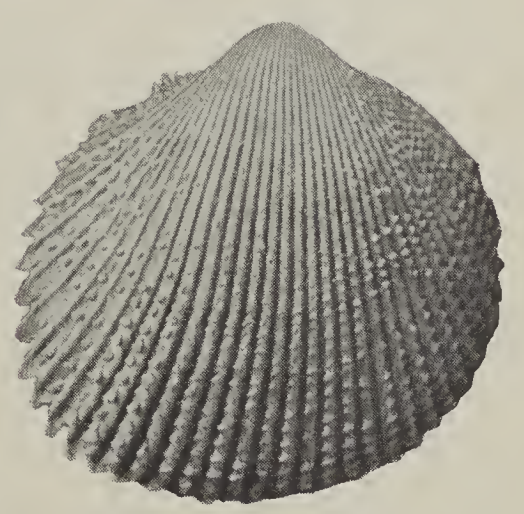
15

16

1 to 3. Diplodonta (Phlyctiderma) gabbi, × 6.
4, 5. Erycina (Erycina) olssoni, × 6.
6, 7. Erycina (Erycina) pura, × 6.
8, 9. Meaeromya menotreta, × 6.
10, 11. Cardium (Acanthocardia?) dissidepictum, × 1.5.
12, 13. Cardium (Trachycardium) lingualeonis, × 1.
14 to 16. Cardium (Trachycardium) bowdenense, × 2.

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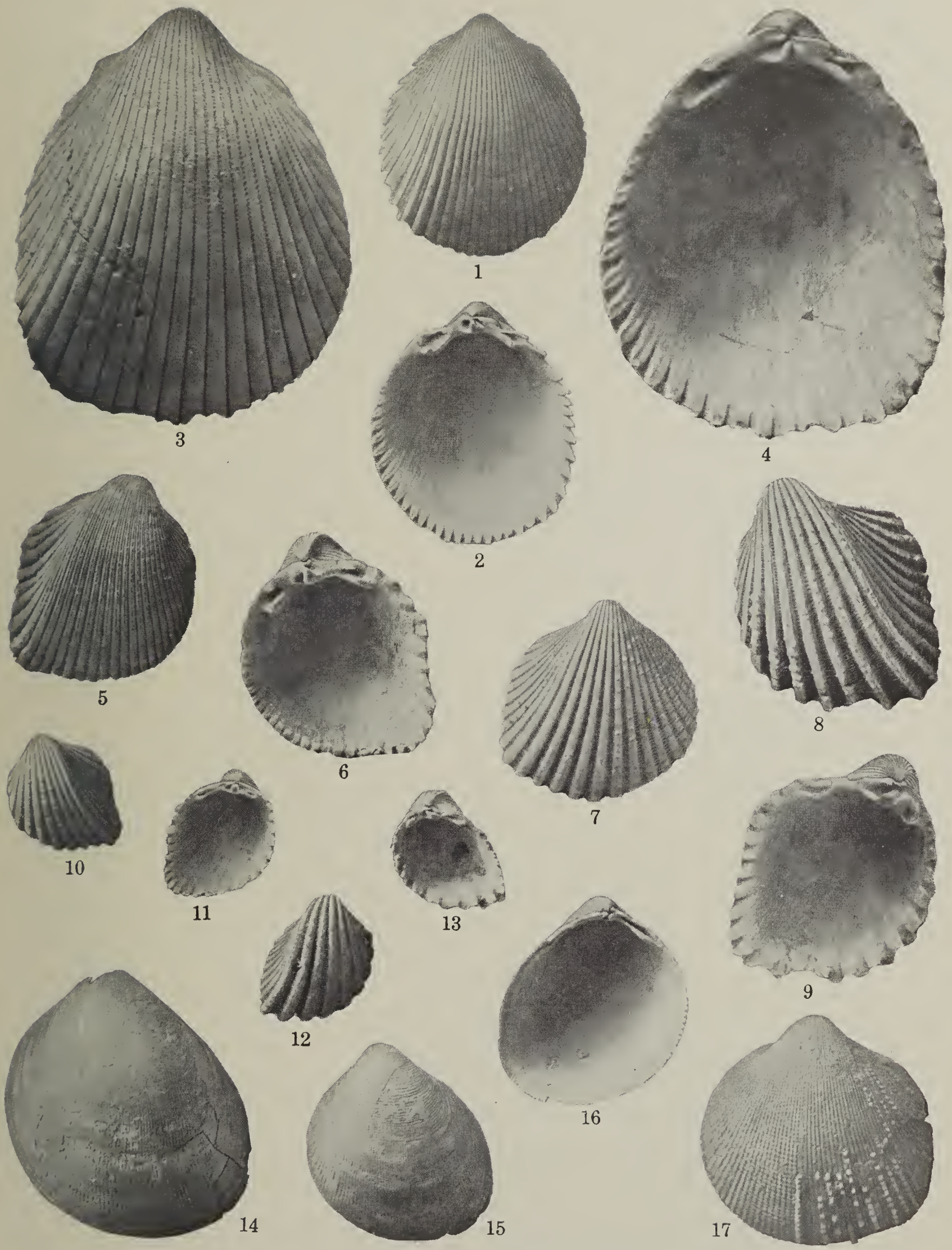

1, 2. Cardium (Trachycardium) inconspicuum, × 1.
3, 4. Cardium (Trachycardium) waylandi, × 1.
5, 6. Cardium (Fragum) medium, × 1.
7. Cardium (Fragum) elattocostatum, × 4.
8, 9. Cardium (Trigoniocardia) haitense haitense, × 1.5.
10, 11. Cardium (Trigoniocardia) haitense cercadicum, × 1.5.
12, 13. Cardium (Trigoniocardia) thaumastum × 2.
14 to 16. Cardium (Laevicardium) serratum, × 1.
17. Protocardia (Nemocardium) jamaicensis, × 4.

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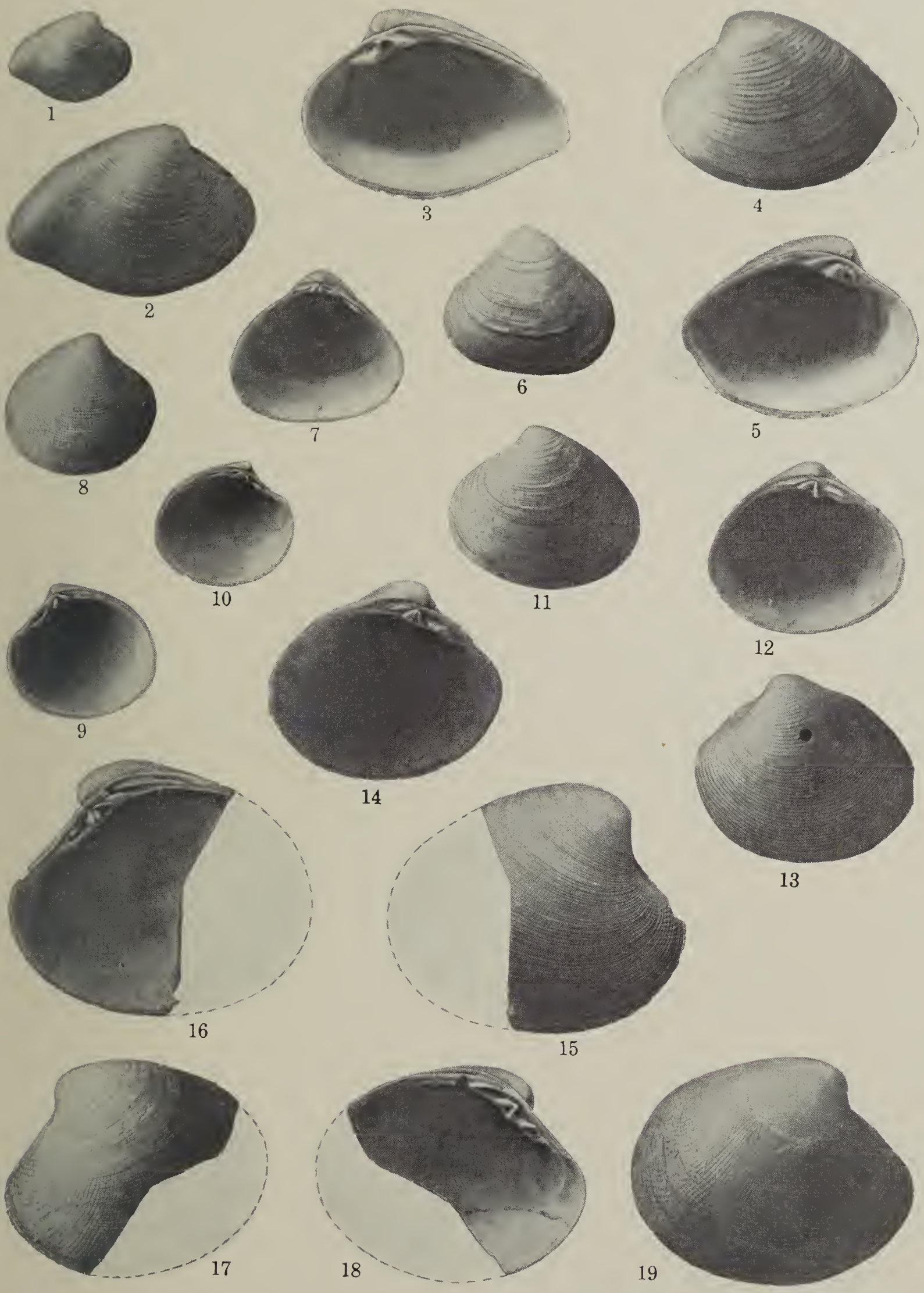

1 to 5. Pliocardia bowdeniana, × 4.
6, 7. Tivela (Tivela) jamaicensis, × 4.
8 to 10. Gafrarium (Gouldia) insulare, × 4.
11, 12. Callocardia (Callocardia) ammondea, × 4.
13, 14. Callocardia (Callocardia) elethusa, × 4.
15 to 19. Pitar (Hyphantosoma) carbaseus, × 1.

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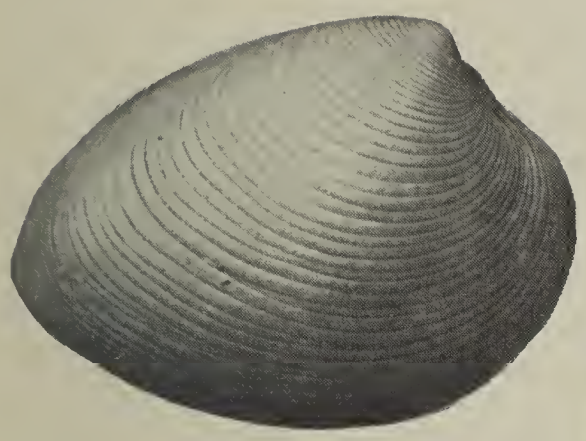

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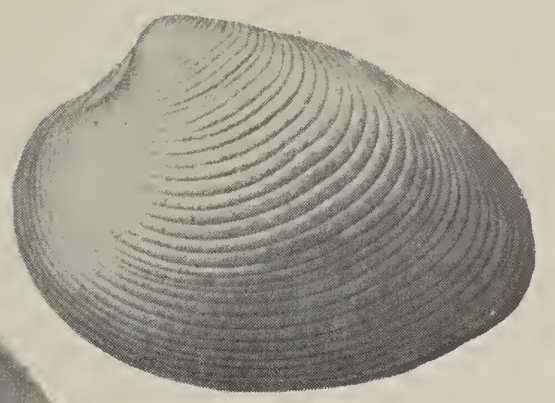

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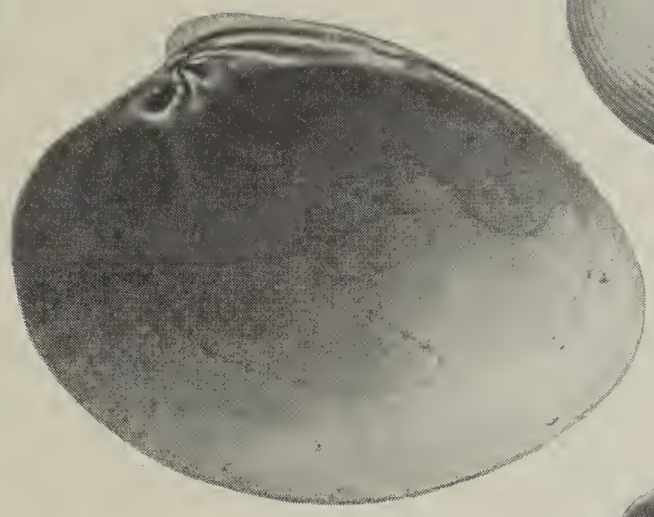

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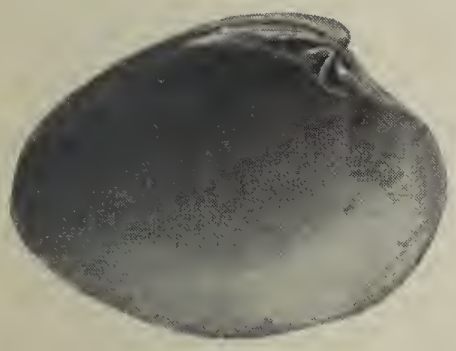

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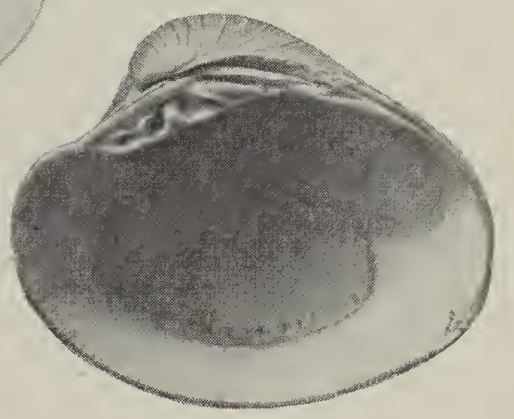

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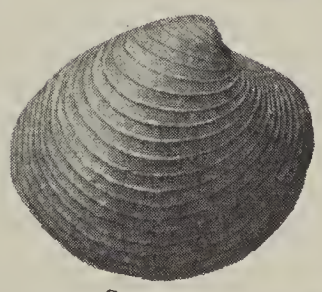

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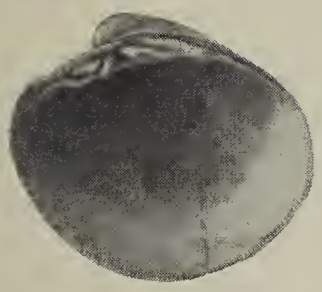

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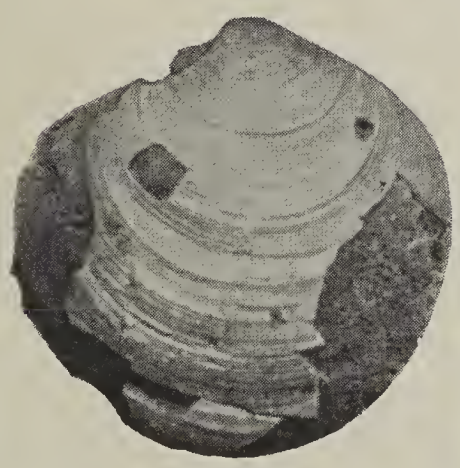

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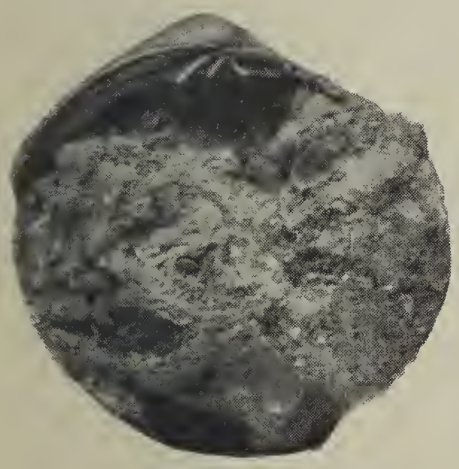

11

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14

1 to 4. Pitar (Hysteroconcha) planivietus, × 1.
5 to 9. Antigona (Ventricola) blandiana, × 1.
10, 11. Cyclinella plasiatenuis, × 1.5.
12 to 14. Chione (Chione) sawkinsi, × 1.5.

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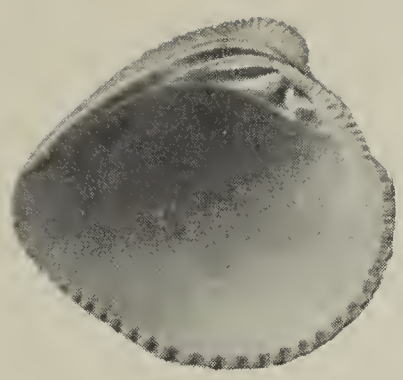
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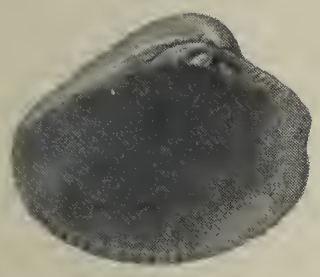
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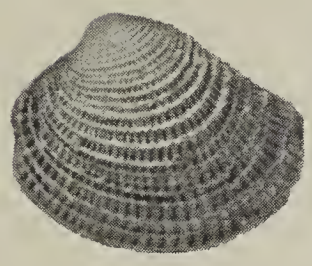
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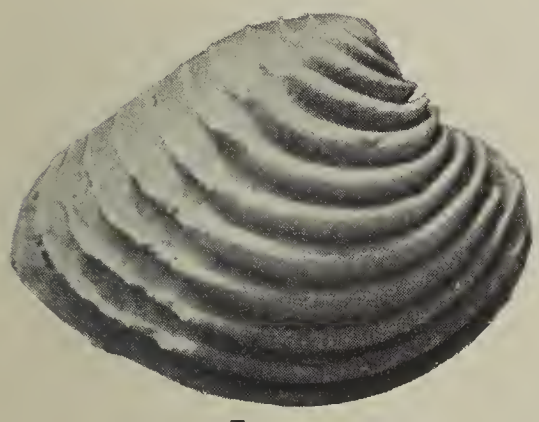
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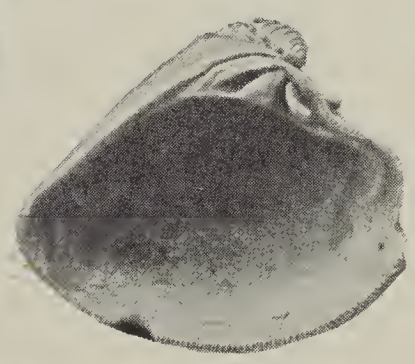
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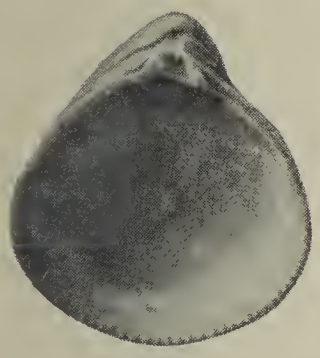
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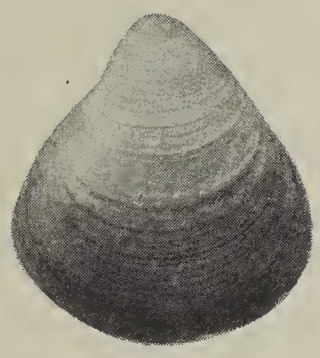
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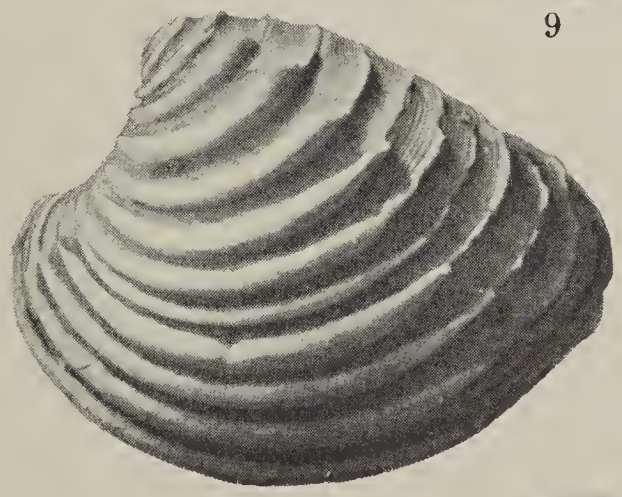
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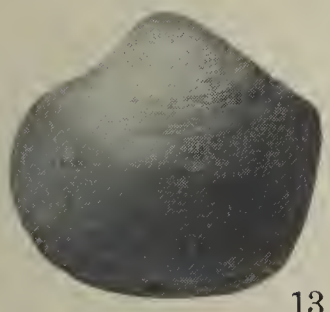
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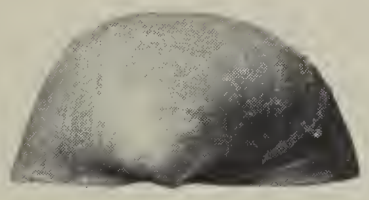
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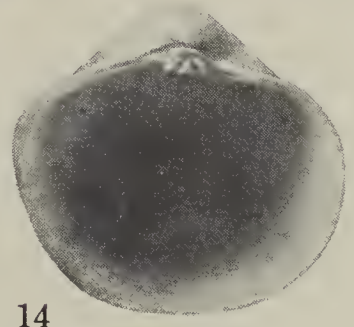
14

1 to 4. Chione (Chione) woodwardi, × 1.5.
5, 6. Chione (Chione) retugida, × 4.
7 to 10. Chione (Lirophora) hendersoni, × 1.5.
11, 12. Parastarte antillensis, × 8.
13 to 15. Cooperella (Cooperellopsis) thaumasta, × 4.

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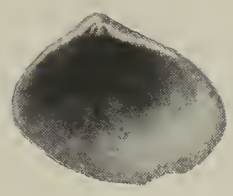
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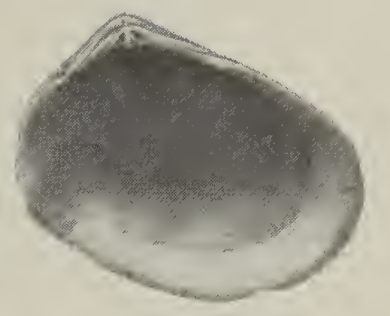
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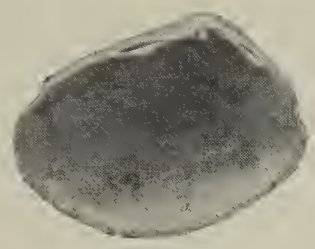
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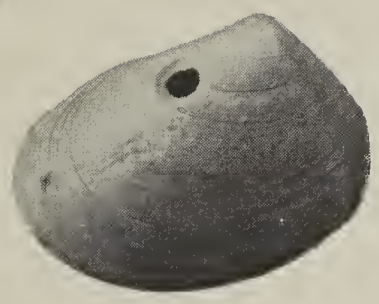
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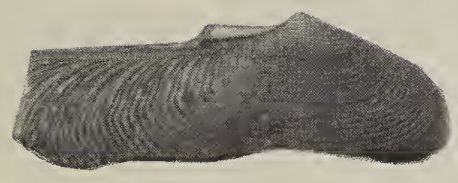
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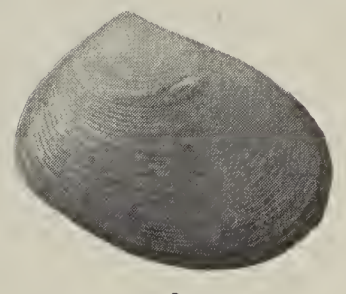
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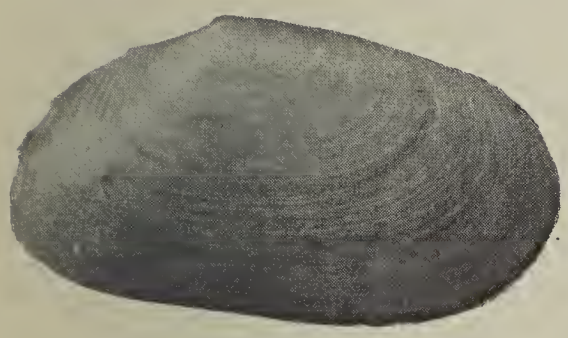
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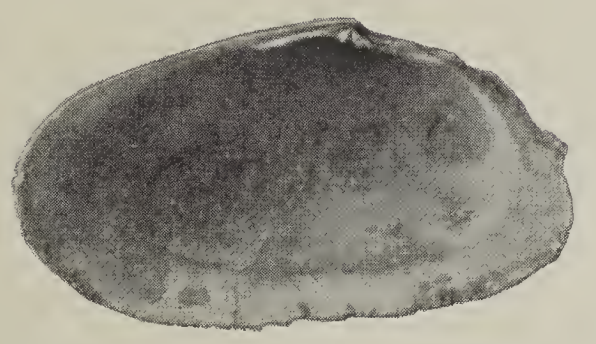
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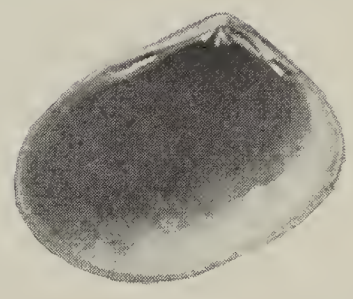
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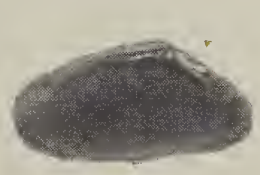
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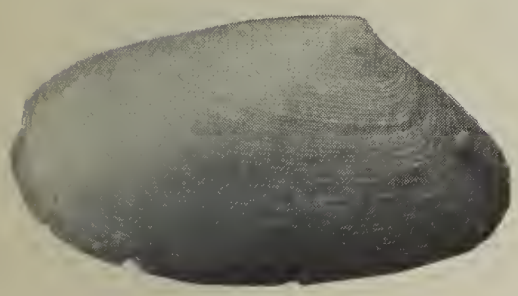
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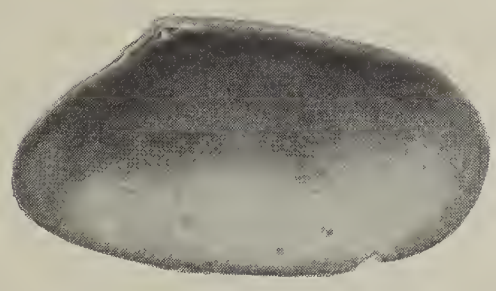
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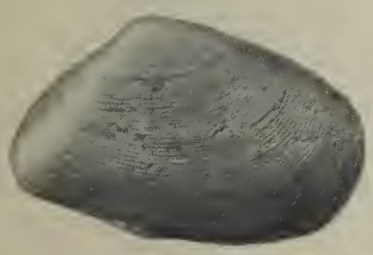
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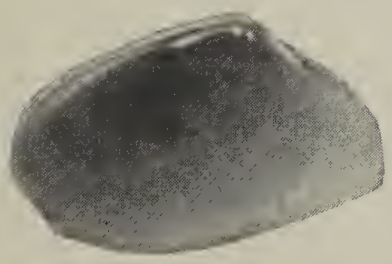
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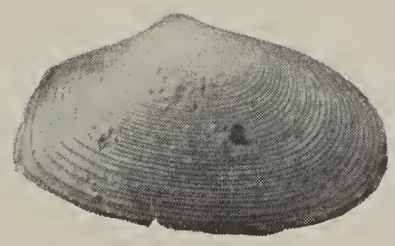
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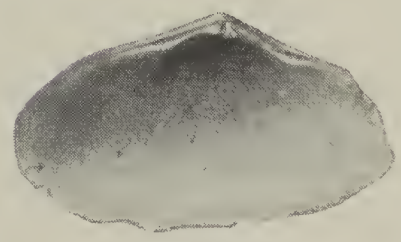
22

1 to 3. Tellina (Moerella) simpsoni, × 4.
4 to 7. Tellina (Moerella) hendersoni, × 4.
8, 9. Tellina (Eurytellina) sp., × 4.
10, 11. Tellina (Eurytellina) spiekeri, × 4.
12 to 15. Tellina (Eurytellina) pharcida, × 4.
16, 17. Tellina (Eurytellina) gonida, × 6.
18. Tellina (Eurytellina) halistrepta, × 2.
19, 20. Tellina (Eurytellina) apomsa, × 6.
21, 22. Tellina (Eurytellina) browni, × 4.

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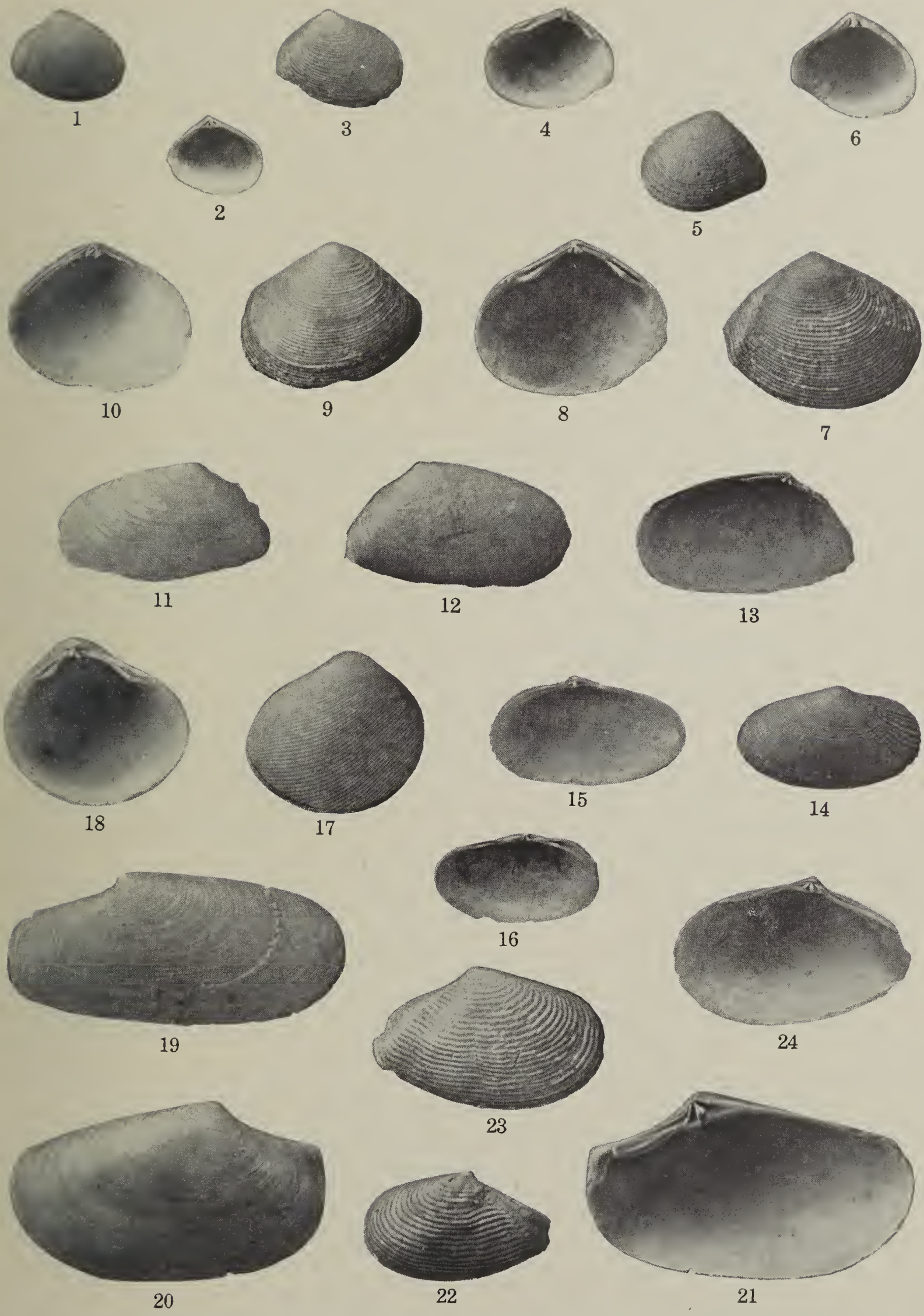

1 to 4. Tellina (Merisca) sclera sclera, × 4.
5, 6. Tellina (Merisca) sclera lerasca, × 4.
7 to 10. Tellina (Merisca) acrocosmia, × 4.
11 to 13. Tellina (Scissula) healyi, × 4.
14 to 16. Tellina (Elliptotellina) cymobia, × 4.
17, 18. Strigilla (Strigilla) pisiformis, × 4.
19. Macoma (Psammacoma) tracta, × 4.
20, 21. Macoma (Psammacoma) olivella, × 2.
22 to 24. Macoma (Cymatoica) vendryesi, × 4.

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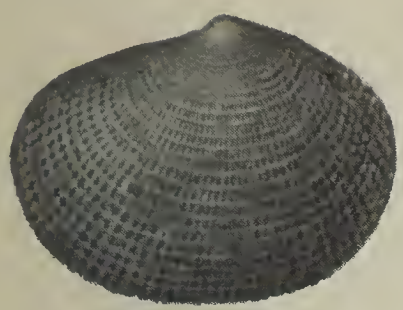
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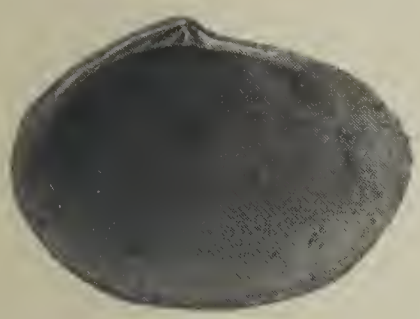
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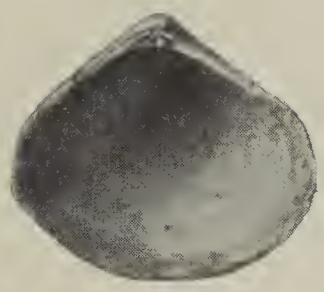
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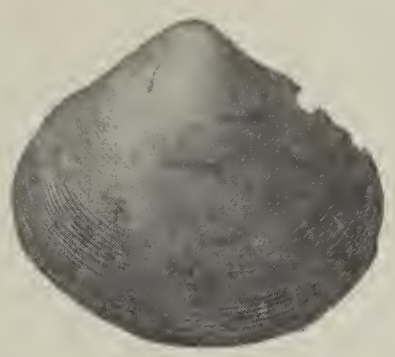
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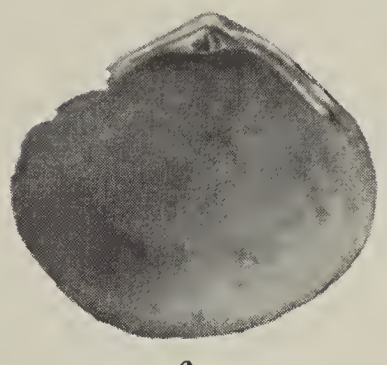
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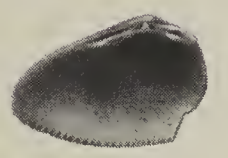
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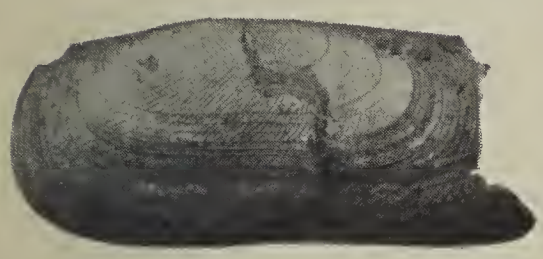
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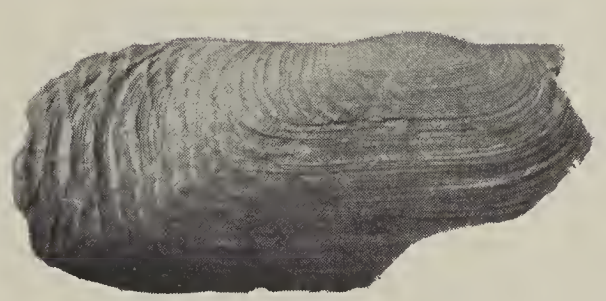
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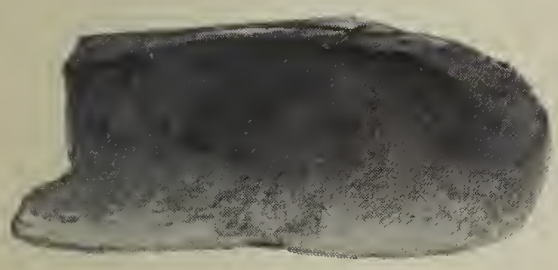
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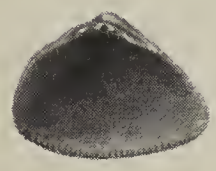
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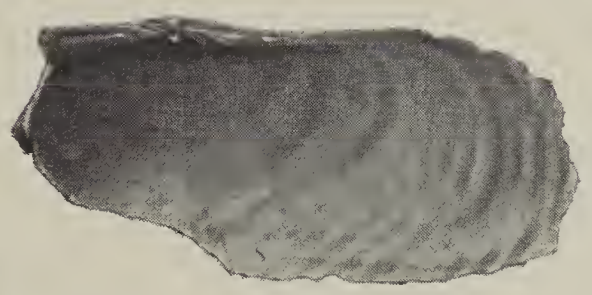
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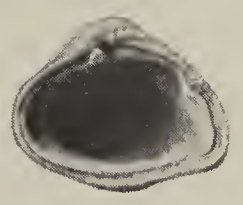
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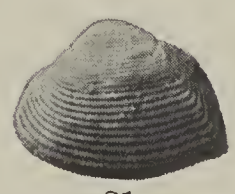
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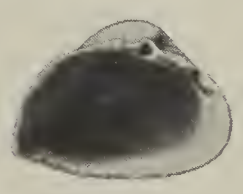
22

1, 2. Semele (Semele) calliconcinnata, × 4.
3, 4. Abra (Abra) triangulata, × 4.
5, 6. Abra (Abra) deutera, × 8.
7, 8. Donax (Donax) sp., × 4.
9, 10. Donax (Paradonax) lennoxi, × 4.
11 to 14. Psamosolen sancti-dominici, × 1.
15, 16. Spisula (Mactromeris) mateleyi, × 1.5.
17, 18. Ervilla gabbi, × 6.
19 to 22. Corbula (Corbula) sericea, × 4.

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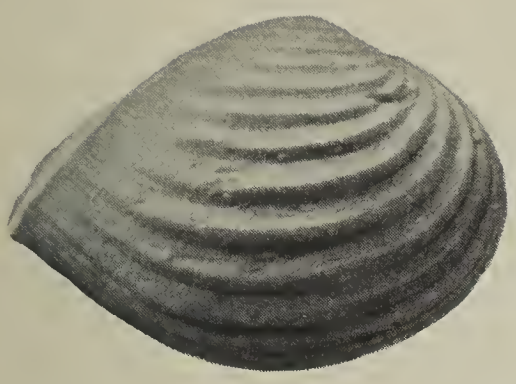

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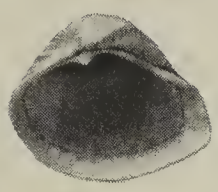

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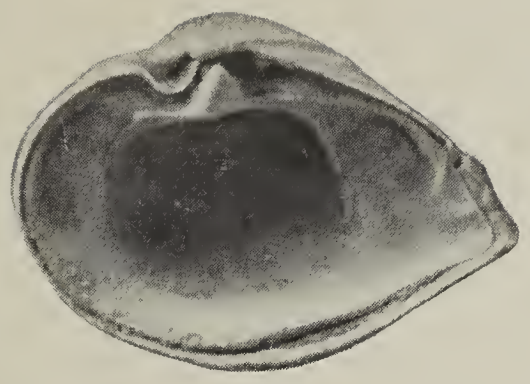

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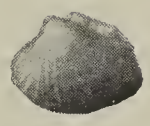

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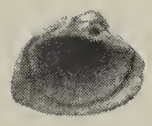

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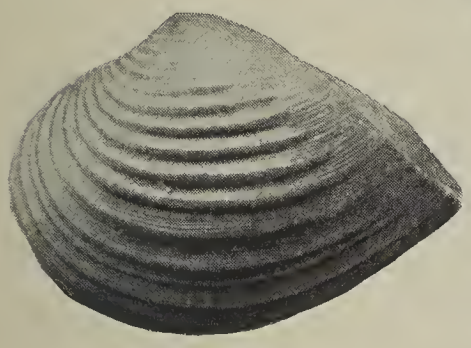

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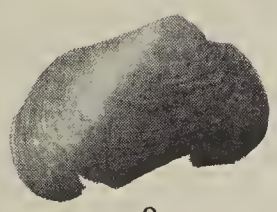

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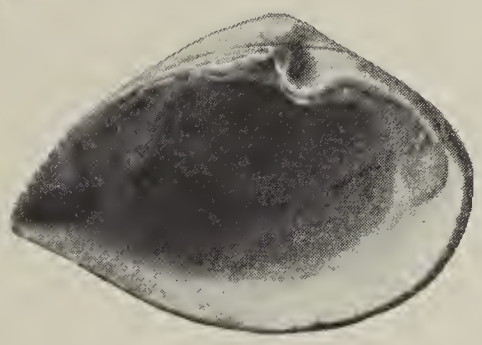

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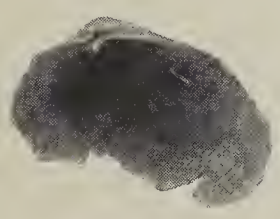

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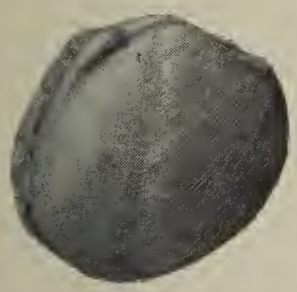

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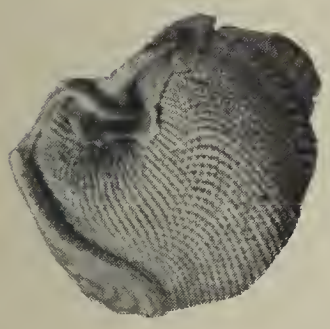

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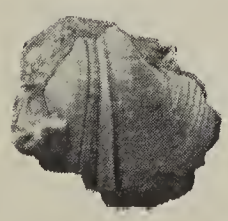

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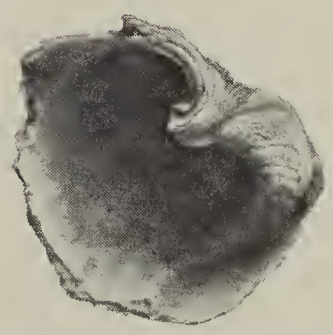

17

1 to 4. Corbula (Corbula) heterogena, × 2.
5 to 8. Corbula (Bothrocorbula) viminea, × 2.
9, 10. Basterotia (Basterotia) bowdeniana, × 2.
11, 12. Gastrochaena (Gastrochaena) rotunda, × 2.
13 to 15. Jouannetia sphaeroidalis, × 4.
16, 17. Martesia bowdeniana, × 4.
18. Xylophaga? sp., × 4.

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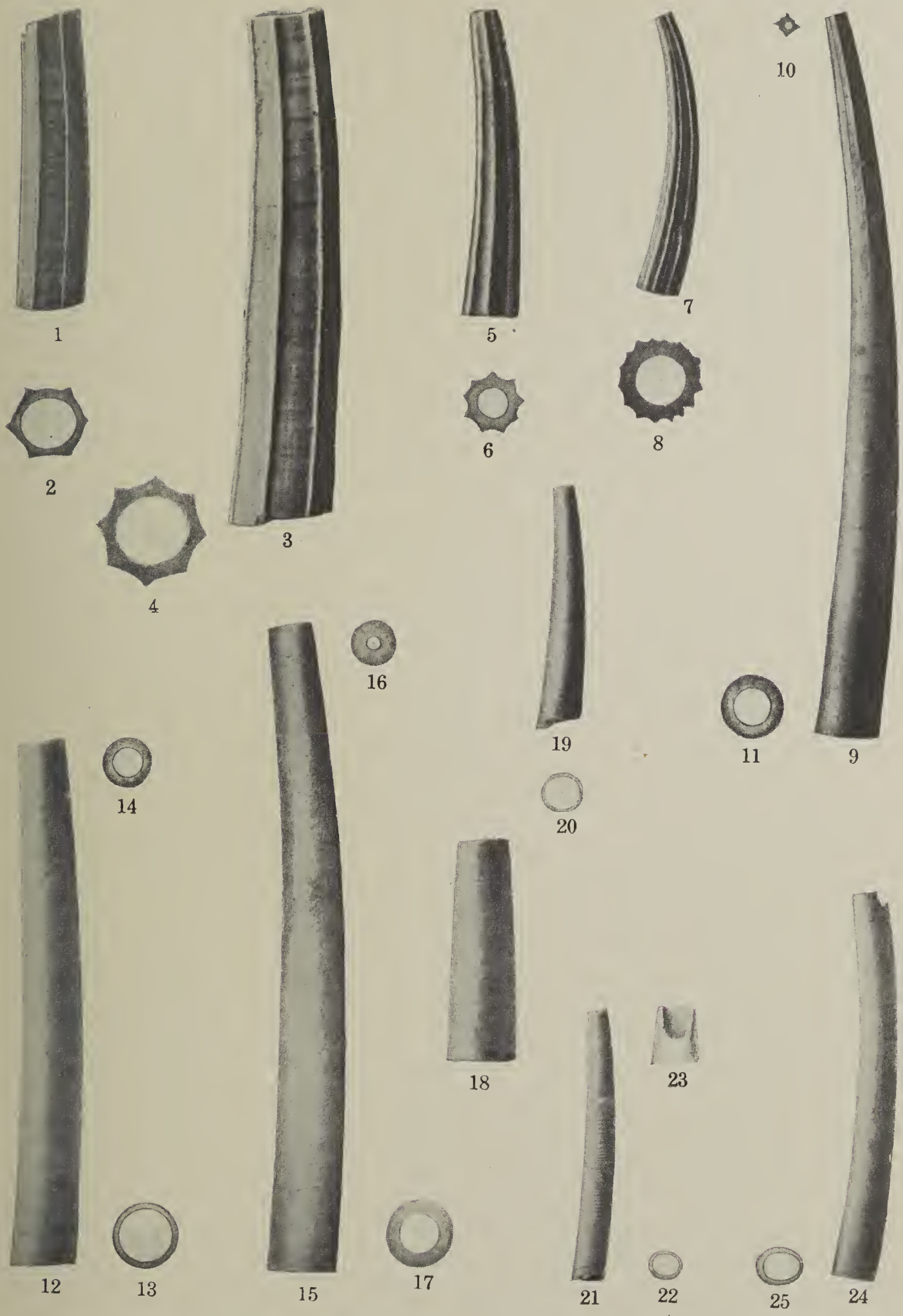

1, 2. Dentalium (Dentalium) cossmannianum, × 4.
3, 4. Dentalium (Dentalium) glaucoterrarum, × 4.
5, 6. Dentalium (Dentalium?) sp. a, × 6.
7. Dentalium (Dentalium?) sp. b., × 6.
8. Dentalium (Dentalium?) sp. b, × 12.
9 to 14. Dentalium (Tesseracme) dissimile dissimile, × 2.
15 to 17. Dentalium (Tesseracme) dissimile ponderosum, × 2.
18 to 20. Dentalium (Laevidentalium) haytense × 4.
21, 22. Dentalium (Episiphon) schumoi, × 6.
23. Dentalium (Episiphon) schumoi, × 12.
24, 25. Dentalium (Episiphon) macilentum, × 6.

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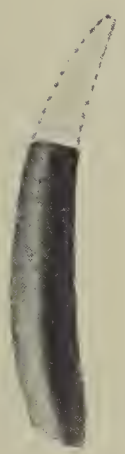

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1. Cadulus (Cadulus) simrothi, × 10.
2. Cadulus (Gadilopsis) dentalinus, × 4.
3. Cadulus (Gadilopsis) dentalinus, × 8.
4. Cadulus (Gadilopsis) hendersoni, × 4.
5. Cadulus (Polyschides) annulatus, × 4.
6. Cadulus (Polyschides) annulatus, × 8.
7 to 9. Cadulus (Platyschides) depressicolis, × 4.
10. Cadulus (Platyschides) pilsbryi, × 4.
11. Cadulus (Platyschides) annectens, × 8.
12. Cadulus (Platyschides) arossus, × 8.

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